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2016

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Parental preventive behaviors and oral health in Latino children

by

Kristin S. Hoefft

DISSERTATION

Submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Epidemiology and Translational Sciences

in the

Copyright 2016

by

Kristin S. Hoefft

Dedication and acknowledgments

I wish to acknowledge the guidance, patience, support and mentorship of my dissertation committee: Robert A. Hiatt, Judith C. Barker, and Stephen Shiboski. I especially thank Judith C. Barker for co-conceiving and developing Contra Caries and providing me the skills and opportunity to take a fully co-investigator role in the entire Contra Caries project. I thank the National Institute of Dental and Craniofacial Research for providing financial support of this project, especially Ruth Nowjack-Raymer for her commitment to interdisciplinary research to reduce oral health disparities. For their endless support, encouragement, humor, instruction, resources, and helpful conversations along the way, I thank my fellow PhD students, especially those in my pioneering cohort; faculty of the PhD in Epidemiology and Translational Science program, especially Robyn Gershon; the Contra Caries team; and colleagues from the Center to Address Disparities in Children's Oral Health (CANDO), especially Stuart Gansky. I also express deep gratitude to my family and friends.

A version of Chapter 1 has been published in BMC Oral Health^[1], and a version of Chapter 2 has been published in the Journal of Community Dentistry and Oral Epidemiology^[2]. The Dissertation Committee members supervised the research that forms the basis of these dissertation chapters and are listed as coauthors on these publications. The published material is substantially the product of Kristin S. Hoeft's period of study at UCSF and was primarily conducted and written by her. The work she completed for these manuscripts is comparable to standard dissertation chapters.

Approved: _____



Robert A. Hiatt, Dissertation Chair

Parental preventive behaviors and oral health in Latino children

by

Kristin S. Hoeft

Abstract

Tooth decay is the most prevalent chronic infectious condition experienced by children in the United States, disproportionately affecting children in low-income Latino families. A theory-based, *promotora*-led curriculum, *Contra Caries* Oral Health Education Program (CCOHEP), was developed to improve low-income Spanish-speaking parents' oral hygiene behaviors for their young children. The objective of this dissertation was to evaluate CCOHEP for acceptability, feasibility, effectiveness, and the utility of Social Cognitive Theory constructs for improving parental knowledge and behavior around their children's oral health. Acceptability was assessed through qualitative analysis of twelve Spanish-language focus groups ($n=51$). Feasibility was assessed through implementation data including attendance and attrition. Effectiveness and theoretical constructs were assessed through a questionnaire verbally administered before, immediately after, and 3 months after attendance at CCOHEP. And within-person change was measured between timepoints. Overall, 105 caregivers participated in CCOHEP ($n= 105$ pretest, $n=95$ posttest, $n=79$ second posttest). At baseline, all parents self-reported doing at least one aspect of toothbrushing correctly, but only 13% reported performing all five aspects according to professional guidelines. At posttest, 44% of parents reported completing all aspects of tooth brushing according to professional guidelines ($p<.001$). Knowledge was high at baseline (mean 12.8 of 16), but 6 knowledge items improved significantly between pretest and posttest. Social Cognitive Theory constructs of outcome

expectations and situation were found to be significantly associated with a caregiver brushing their child's teeth twice a day at baseline and with improvements in that behavior after CCOHEP. Self-efficacy to brush child's teeth with fluoridated toothpaste, outcome expectation, and environment were all significantly associated with caregivers brushing child's teeth with fluoridated toothpaste at baseline and with improvements in that behavior after CCOHEP. Eight of the 10 measured SCT constructs improved after attendance at CCOHEP, and were maintained or further improved 3 months after. CCOHEP was acceptable to and improved low-income Spanish-speaking parents' oral hygiene knowledge and self-reported behaviors for their young children, and change was sustained 3 months after the end of the intervention. Five social cognitive theory constructs were associated with baseline behaviors and improvements in behavior. Further study of CCOHEP is warranted.

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Introduction

A. BACKGROUND AND SIGNIFICANCE

Definition and etiology

Early childhood caries (ECC) is tooth decay of the primary teeth, indicated by the presence of one or more decayed, missing (due to caries), or filled tooth surfaces on a child 6 years of age or younger^[3]. ECC is a multifactorial disease, and is influenced by biological, behavioral, family, community and environmental level factors^[4]. It is primarily caused by *Streptococcus mutans* bacteria (sometimes passed through vertical transmission from caregivers), along with cariogenic substrate (sugars and carbohydrates)^[5]. It can be prevented with toothbrushing with fluoride tooth paste and other applications of fluoride to strengthen tooth enamel, as well as decreased frequency and quantity of carbohydrate and sugar consumption^[6, 7].

Rural, Mexican-Origin Children are at very high risk of suffering from ECC

ECC is the most prevalent chronic infectious condition experienced by children in the United States, affecting 28% of all 2-5 year olds.^[8] It is much more likely to affect low-income, migrant, rural and racial/ethnic minority populations.^[9-12] For example, Mexican American children are more than twice as likely as their non-Hispanic white (hereafter white) and black counterparts to experience ECC; they also have more severe, extensive and untreated decay.^[9] For example, low-income Mexican American aged 2-5 years have an average of 1.9 decayed or filled teeth, compared to 1.15 in same age low-income African Americans and white children^[13]; and only 76% of Mexican American aged 2-4 years are caries-free, compared to 87% of same

age non-Hispanic whites^[14]. Although rural/urban differences in ECC in nationally representative samples have not been studied, small localized studies of rural Mexican American and Latino populations have found very high prevalence of ECC, including high burden of untreated ECC^[10, 15-17]. Though much progress has been made in decreasing prevalence of dental caries generally, this particularly vulnerable population has witnessed an increase in ECC prevalence in recent years: from 18% of 2-4 year olds in 1988-94 to 22% in 1999-2005; low-income and Latino children suffer higher increases than the general population.^[8, 18]

Consequences of ECC

At the individual (child) level, ECC can lead to pain; difficulties with everyday activities such as eating, sleeping, learning and playing; and abscesses and acute systemic infection.^[9, 19, 20] Long-term, ECC can have far-reaching and permanent consequences such as speech issues, higher risk for future dental caries and problems with permanent dentition.^[21] At the national level, pediatric dental care costs above 35 billion dollars annually, and it is estimated that children miss 52 million hours of school a year due to dental problems.^[9] As a result, parents also miss days of work to take their children to receive dental treatment, and for those in jobs like farmwork they can even lose their job.^[22]

B. ECC PREVENTION

Because ECC affects children 6 years of age and younger, traditional prevention strategies work differently in this very young population. For example, many children do not access the dentist at an early enough age to prevent ECC,^[23-26] making clinic-level interventions, such as the regular application of fluoride varnish less accessible to this population.^[27] Furthermore, community water fluoridation may not be as effective in this population, especially

in rural situations where fluoridation is less common than in urban areas.^[28-30] Fluoride is also available in home hygiene products such as fluoride toothpaste, although over half of children at the youngest end of this target age group currently are not brushing their teeth regularly, despite its recommendation by American Academy of Pediatric Dentists.^[31-33] Reduction in frequent consumption of sweet drinks and fermentable carbohydrates has also been recognized as an important preventive behavior in ECC, though limited evidence currently exists about how best to reduce such dietary exposures.^[34]

The Role of Parents/Caregivers in ECC Prevention

While it is accepted that ECC is a disease with influences from all facets of the social ecological framework,^[4] the role of parents or caregivers (hereafter “parents”) in young children’s oral health is particularly important.^[4, 22, 35] Young children are dependent on their parents to help care for their oral health needs and to establish healthy practices, such as consuming healthy drinks and snacks, weaning from the bottle by age 1 year, toothbrushing, and regular visits to an oral health professional.

Understanding Parental Toothbrushing Behaviors

Parental toothbrushing behaviors for their children have only been partially explored in the literature. A study of low income parents of Latino children aged 1-5 years found that toothbrushing with fluoridated toothpaste was one of the two most acceptable ECC prevention strategies.^[36] Qualitative research has described contextual factors, beliefs and motivations around oral hygiene care for their children^[33], finding that urban Latino parents tended to be unaware of the correct age to start their children on a regular toothbrushing regimen, relying

instead on certain maturation factors, such as erupted molars to begin regular toothbrushing. Many parents had trouble maintaining a daily toothbrushing regimen with uncooperative children, and did not appreciate the need to manually assist their young children in toothbrushing until age six.^[37]

Social Cognitive Theory and Parental Toothbrushing

Many educational interventions have been used with a goal to improving children's oral health but few have been theory-based.^[38] It is well known that interventions that are soundly based on theoretical principles have more desired outcomes than other interventions^[39]. Behavioral theories, such as Social Cognitive Theory (SCT) are widely used to explain and predict protective and preventive health behaviors in other health areas, but have rarely been applied in ECC.^[39, 40]

SCT addresses psychological, social, and environmental factors influencing health behaviors.^[41, 42] It consists of 11 constructs likely to explain behavior change such as self-efficacy, behavioral capability, environment, and outcome expectations. An important component of SCT, self-efficacy, refers to the confidence one has to carry out a protective action in a variety of situations. High oral health self-efficacy has been shown to be associated with toothbrushing in African American parent-child dyads in Detroit and a multi-national study, but it has not been specifically examined in the U.S. Latino population, which may be different due to differences in culture, language and health literacy.^[43-45] The literature connecting the other SCT constructs with oral health interventions is extremely limited; though SCT has been used to explain oral hygiene behaviors among university students in Germany and North Dakota.^[46, 47]

Health Education to Prevent ECC

Health education is one possible avenue to help influence parental behavior around their children's oral health. While research across many health behaviors suggests that knowledge alone is insufficient for sustained behavior change, health interventions based around health behavior theory, especially those with skill-building components have shown more promising results than didactic programs^[39, 48]. Few oral health interventions exist targeting low-income Spanish-speaking parents of young children^[49, 50]. Moreover, very few have been evaluated or theory-based^[51-53]. Oral health promotion programs for children generally are not culturally or linguistically specific for Latino or Mexican American populations; tend to target older children through schools and preschools; and rarely include parents/caregivers in these education efforts^[38, 50, 54].

Yet parents/caregivers are important for children 5 years and under, as it is the parent who primarily manages the child's diet, supervises their behavior, undertakes oral care practices and seeks professional dental services. For example, Douglass and colleagues found that children who had parents assist in brushing their teeth had lower prevalence of caries than children whose parents did not assist^[31]. Inclusion of parents in oral health education may be particularly important for Latino families, as immigrant parents may have lower than average education, and limited oral health literacy and facility to navigate dental care systems in the United States.^[23, 26, 55, 56]

To address this gap in linguistically and culturally appropriate education for Spanish-speaking parents of young children, the program *Contra Caries* Oral Health Education Program was developed.

C. CCOHEP INTERVENTION

Despite young Latino pediatric populations having a demonstrated need for oral health interventions, very little oral health research in the U.S. has focused on devising and evaluating preventive educational activities specifically for this unique population. Far more interventions exist to address caries in school age or older children, and only a few of those interventions include education and skill building for parents, who have an important role in young children's oral health, and where the opportunity for prevention and long term health benefits is most likely.

Contra Caries Oral Health Education Program (CCOHEP) was developed as a community-oriented, multi-level intervention educational program based on SCT. SCT constructs provide the foundation for the intervention (such as observational learning, monitoring, and skill building) with the specific design and format of those factors shaped by community input and feedback during the development and piloting phases.^[57] Developed and administered entirely in Spanish, it is tailored to cultural beliefs and knowledge particular to the Latino population, such as addressing the false belief that the plastic from a baby bottle's nipple rots teeth rather than the sweet liquid in the bottle.^[22, 55, 58]

CCOHEP Classes

Each CCOHEP class consisted of four 2-hour sessions guided by a trained lay health educator (*promotora*), using interactive activities and skill-building to improve parental understanding and performance of protective oral health behaviors to prevent ECC. The content of the sessions included topics such as: assisting toothbrushing with fluoride toothpaste, managing uncooperative child behavior to achieve toothbrushing, reducing nighttime bottle use,

reducing frequency and volume of dietary sugar and starch consumption, and seeking regular dental visits for children starting at age 1. Classes were conducted in Spanish by trained *promotora* in a small-group, interactive setting in social service locations, allowing parents to learn from and support each other, practice new skills in the class, and ask questions.

As part of the feasibility and acceptability evaluation of CCOHEP, focus groups were conducted and a survey measuring knowledge, behaviors and SCT constructs was developed and administered at three time points. These activities are the data sources for the research presented here.

D. CCOHEP DATA

A longitudinal study was conducted, collecting knowledge, attitudes and behavior data before after and three months after the CCOHEP intervention. Data collection for CCOHEP was undertaken during an R21 research study funded by the National Institute of Dental and Craniofacial Research (grant # R21 DE019210 J.C. Barker, PI). All study procedures were approved by the Institutional Review Board of University of California, San Francisco (Approval number 11-05603). The project was undertaken with predominantly low-income, Spanish-speaking parents of children aged 1-5, in a rural city in California. Participants were a convenience sample of 110 parents (mainly mothers around 31 years of age) recruited through social services such as the Women, Infant and Children federally-funded nutrition supplement program (WIC), low-income public housing complexes, and a non-profit organization that provides free daycare for families who do farmwork. Participants answered a verbally-administered survey about themselves and a “focal child” closest to age 3 prior to receiving the

intervention. Parents received a \$20 gift card to a grocery store as compensation for completing the pretest, another for completing the posttest, and \$30 gift card for the second posttest. Surveys were administered at baseline T0 (n=110), immediately at completion of intervention T1 (n=95), and 3 months after intervention completion T2 (n=79). The database from this initial project consists of de-identified survey data used for these analyses.

Measures

The questionnaire consisted of author-written questions and questions from the Basic Research Factors Questionnaire for studying early childhood caries (BRFQ), an instrument developed by the Early Childhood Caries Collaborative Working Group across the three NIDCR-funded centers to address children's oral health disparities. The questionnaire contained a total of 83 questions, including 11 measures of oral health behavior (including 5 on toothbrushing and other questions on other protective behaviors like dental visits). These survey items are designed to measure behaviors supported by the American Academy of Pediatric Dentistry and American Academy of Pediatrics as beneficial for children's oral health^[59, 60]. Additional questions addressed SCT constructs: self-efficacy, behavioral capability, outcome expectation, and environment for toothbrushing. Before use, the survey underwent cognitive interviews and pilot testing with Spanish-speaking parents similar to those in the study population.

E. OVERVIEW OF THE DISSERTATION

Overall objective of dissertation:

The goals of this dissertation are to delineate the cognitive factors influencing protective parental oral health behaviors, such as toothbrushing, and to conduct an evaluation to determine

if Contra Caries improved quantity and quality of protective behaviors, especially but not exclusively toothbrushing, in this population. Ultimately, my goal was to create new knowledge in the field of oral health epidemiology and to translate evidence-based interventions into improved early childhood oral health.

I was a co-investigator for the original CCOHEP program. In that capacity, I assisted with the grant writing and submission process; developed and refined CCOHEP curriculum; hired, trained and led the research team and *promotora*; designed and led the focus groups; lead the survey design; oversaw participant recruitment and data collection; oversaw data management, tracking and storage, and monitored data fidelity; cleaned the data, and conducted all data analyses presented in this work, with advisement from my Dissertation Committee. Data analyses were supported by receipt of an F31 dissertation grant from NIDCR (F31DE023282, K. S. Hoefft, PI).

The specific aims of the papers that comprise this dissertation are:

1. Using community participation to assess acceptability of "Contra Caries", a theory-based, *promotora*-led oral health education program for rural Latino parents: a mixed methods study.^[2]

To assess the acceptability and feasibility of CCOHEP, and solicit community feedback to refine the CCOHEP curriculum.

2. Effectiveness evaluation of *Contra Caries* Oral Health Education Program for improving Spanish-speaking parents' preventive oral health knowledge and behaviors for their young children^[1]

To determine if CCOHEP is associated with changes in parental self-reported knowledge or behavior at the post-test and 3 month post-test (maintenance).

3. Social cognitive theory and Spanish-speaking parents' preventive oral hygiene behaviors for their young children

To determine if SCT constructs (behavioral capability, outcome expectations, self-efficacy, situation, and environment) are positively associated with protective oral health behaviors, whether these constructs changed after participation in CCOHEP, and if those changes were associated with behavior changes.

These three papers combine to build a strong foundation for understanding more about low-income Spanish-speaking parents' knowledge and behaviors around their children's oral health, and especially laying the groundwork for future research to explore in-depth the factors driving behavior change in this population. This body of work provides in-depth pilot data for CCOHEP and whether it might be a suitable approach to improving parental behaviors for their children's oral health, and it identifies some potential mechanisms or avenues for behavior change that could inform intervention research with other populations.

Chapter 1: Using community participation to assess acceptability of "Contra Caries", a theory-based, promotora-led oral health education program for rural Latino parents: a mixed methods study

ABSTRACT:

Background: Latino children experience more prevalent and severe tooth decay than non-Hispanic white and non-Hispanic black children. Few theory-based, evaluated and culturally appropriate interventions target parents of this vulnerable population. To fill this gap, the *Contra Caries* Oral Health Education Program, a theory-based, *promotora*-led educational program for low-income, Spanish-speaking parents of children aged 1-5 years, was developed. This article describes qualitative findings of the acceptability of curriculum content and activities, presents the process of refinement of the curriculum through engaging the target population and *promotoras*, and presents results from the evaluation assessing the acceptability of the curriculum once implemented.

Methods: Focus groups were conducted with low-income Spanish-speaking parents of children 1-5 years living in a city in an agricultural area of California. Interviews were digitally recorded, translated and transcribed, checked for accuracy and the resulting data was thematically coded and analyzed using a social constructionist approach. The *Contra Caries* Oral Health Education Program was then implemented with a separate but similar sample, and after completing the program, participants were administered surveys asking about acceptability and favorite activities of the educational program. Data were entered into a database, checked for accuracy, open-ended questions were categorized, and responses to close-ended questions counted.

Results: Twelve focus groups were conducted ($N=51$), 104 parents attended the *Contra Caries* Oral Health Education Program, and 83 parents filled out surveys. Complete attendance and retention was high (89% and 91%). This study found that their children's oral health is a high priority. Parents were not only interested in, but actually attended classes focused on increasing their knowledge and skills with respect to early childhood oral health. The *Contra Caries* content and format was perceived as acceptable by parents. Strong opinions about curriculum content were expressed for including information on how caries starts and progresses, weaning from the bottle, oral health care for children and adults, motivational strategies for children's tooth brushing, dental visits and cavity restorations

Conclusions: The *Contra Caries* Oral Health Education Program was acceptable to low-income, Spanish-speaking parents of children 1-5 years. Participating in the curriculum development and revision process likely played an important role in the parents' high acceptability of the program.

BACKGROUND:

Early childhood caries (ECC), or tooth decay of the primary dentition, affects 28% of children aged 2-5 years in the United States^[8]. ECC causes pain that can interrupt activities of daily living such as eating, sleeping, playing and talking, and can result in serious health consequences if left untreated. Pain resulting from ECC and the time to seek treatment can result in missed work for parents, missed school for children, and reduced school performance^[61]. In addition, ECC can have long-lasting effects on oral health, self-esteem, and even employment^[22, 62]. ECC is a multifactorial and largely preventable disease, with influences at multiple levels of organization, from individual to societal^[4].

Mexican American children are more likely than non-Hispanic white and non-Hispanic black children to have experienced ECC, have more affected teeth, more severely affected teeth, and more untreated decay^[9, 63]. Rural, migrant and farm-worker children have especially poor oral health, particularly if they are also Latino^[10, 16]. The Latino population is the fastest growing and largest minority population in California and the U.S. Overall, 38% of California's population is Latino and of these over 14 million people, 83% are Mexican-origin^[64].

While it isn't known exactly why Latino children experience disproportionately high prevalence and severity of ECC compared to non-Hispanic white and black children, initial research suggests that there are multiple inequalities experienced by this population including language and health literacy, access to and perceived need for oral care, rejection of tap water consumption, sugary drink and juice consumption, confusion around infant bottle use and late bottle weaning^[15, 22, 29, 65-67].

While not the only step in prevention, oral health education is a critical and important factor in preventing ECC. Education is especially important for this vulnerable population, since

many Latinos have less access to other proven ECC interventions, such as professional oral health care^[65]. Theory-based interventions are more successful than those with other approaches^[39], and education designed with and for particular cultural and linguistic groups are more successful than those developed generically and simply translated for other target populations. Using *promotora*, i.e., trained lay health educators from the local community, is a culturally appropriate approach to delivery of health interventions, and has been shown to be effective at creating behavior change for other (non-dental) health conditions^[68-71].

However, most existing ECC prevention education programs lack a theoretical basis and have not been formally evaluated. They have not involved *promotoras* and are focused at preschool age and older children directly, thus missing the critical prevention window for children under age 3 who are primarily dependent on their parents or caregivers for access to dental visits, exposure to and development of home care habits (such as providing child with a toothbrush and toothpaste, tooth brushing assistance), as well as diet (for example, low-cariogenic foods and drinks). Finally, very few educational are developed for specific vulnerable populations such as Latinos.

Given the high need for oral health promotion education in low-income, rural, Latino populations in California, we set out to develop and test *Contra Caries* Oral Health Educational Program (referred to as *Contra Caries*), a theory-based, *promotora*-led oral health educational program targeting low-income, Spanish-speaking parents of children aged 1-5 years. A preliminary curriculum consisting of four sessions on key topics was developed in Spanish by the authors based on: 1) findings in the literature from previous ethnographic research in similar Latino populations^[22, 33, 58] which helped identify knowledge, behaviors, and skills to target with the intervention; and 2) two specific theories. First, we employed Stokols' social ecological

model as a broad contextual framework within which we adapted Bandura's Social Cognitive Theory^[35, 41]. Stokols describes behavior influences at five levels: intrapersonal, interpersonal, organizational, environmental, and socio-cultural. While *Contra Caries* was too small to examine influences at all five levels, it was designed to be mindful of the other influences upon an individual's behavior and provide suggestions and support for counteracting barriers encountered at the more structural rather than familial levels. Social Cognitive Theory is a comprehensive social-psychological theory which is compatible with a social ecological approach and includes key constructs (such as self-efficacy) known to positively affect oral health and influence daily behavior^[72]. Bandura's model lends itself to not just increasing parental oral health knowledge but also to skill-building and behavior change.

Objective:

This article describes qualitative findings of the initial acceptability of curriculum content and activities, presents the process of refinement of the curriculum through engaging the target population and *promotoras*, and presents results from the evaluation assessing the acceptability of the curriculum once implemented.

METHODS:

This study was conducted in a medium-sized city in an agricultural area of California. Because the city's economy is so heavily based around the production and distribution of agricultural products and associated services, we use the phrase 'rural' in this manuscript to distinguish it from urban sites with more diversified economies. Because rural Latino children have very poor oral health^[8-10, 22, 63], we choose to locate study in a rural setting, in a different geographic

location than our previous ethnographic work, but with a similar Latino immigrant population.

Figure 1 presents in schematic form the steps undertaken in the two phases of this project, with the methods of each detailed separately below.

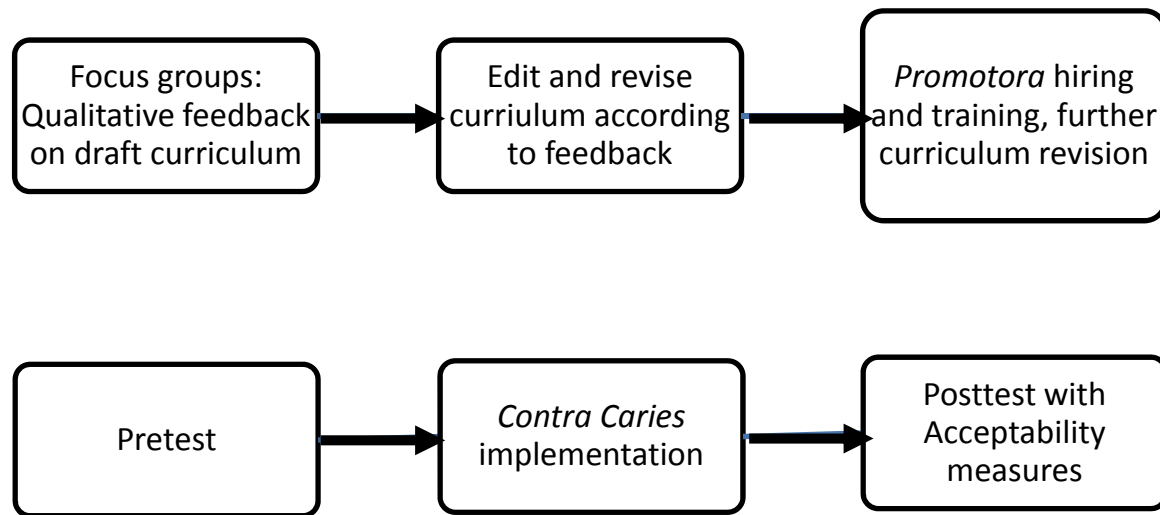


Figure 1: Steps undertaken in the study

Phase 1: Focus Groups

We partnered with the Community Oral Health Services, a community-based organization that focuses on providing dental services to underserved populations, co-locating in their office that is well situated in a predominantly Latino neighborhood of the community. This organization facilitated introductions to community organizations for participant recruitment.

Phase 1 data collection consisted of focus groups with community members so they could assess the draft content, format, and logistics of the draft curriculum^[57]. Qualitative focus groups were conducted in Spanish and led by two bilingual researchers. Proposed class activities

integral to the *Contra Caries* curriculum were presented to the focus groups participants who were asked to give detailed feedback on what they liked, didn't like, and how they would like to change things, both for content of the lessons and the format of the activities. Focus group inclusion (selection) criteria required participants be low-income, Spanish-speaking caregivers of at least one child between ages 1 and 5 years. Participants were non-randomly recruited (convenience sample) from community festivals and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Focus groups lasted 2 hours, were held in community organization sites, and participants received a \$25 gift card to a local supermarket for participation. Focus groups were conducted until we reached saturation on the key topics of interest. Discussion was recorded and the audiotapes transcribed verbatim, checked for accuracy, and observations of interaction during the groups were summarized as typed field notes. The resulting data was thematically coded and analyzed using a social constructionist approach, developing codes from the data in an inductive process, and using QSR International's NVivo 10 software to apply codes to transcript text. All study procedures were reviewed and approved beforehand by the Committee for Human Research (Institutional Review Board) at the University of California, San Francisco (Approval number 11-05603).

The information from the focus groups was used to revise the curriculum content and delivery style. Then *promotoras* were hired and trained in order to conduct a pilot study of the full curriculum. Potential *promotoras* were recruited through flyers and in-person recruiting in local businesses (such as *tiendas* and laundromats) and social services such as WIC. A bilingual application form was given to interested applicants, applicants were interviewed in Spanish, and 4 of the 14 applicants were selected and hired as *promotoras*, based on the criteria identified in the focus groups (reported in Results below). Training of the *promotoras* was conducted

intermittently over a 5 month period, ranging from a few hour orientations 3 days a month at the beginning, to all-day practice sessions two days a week by the end. Training included teaching oral health information using the *Contra Caries* curriculum, as well as group facilitation, study procedures and record keeping, and ethics. *Contra Caries* curriculum was even further refined with input from *promotoras* as they practiced leading the curriculum in preparation for its implementation.

Phase 2

Phase 2 involved implementation of the revised *Contra Caries* classes and use of surveys asking about acceptability and favorite activities of the educational program. A separate, larger convenience sample of participants was recruited with the same inclusion criteria and recruitment procedures as in Phase 1. These participants signed up to attend *Contra Caries* classes, 4 sessions of two-hours each, and to fill out surveys. Classes were held in community locations such as WIC classrooms or apartment building common rooms, and were led by the trained *promotoras*.

A brief overview of curriculum content is provided in Table 1. A number of teaching modalities were employed in delivering the oral health information to study participants, including group discussion and sharing, *promotora* demonstrations, interactive group problem-solving, visual story-telling, goal setting and check-ins, practicing skills and giving and receiving feedback. Activities incorporated throughout the sessions were designed to reinforce topical content: for example, spooning out sugar to visualize the quantities on nutrition labels, using plaque disclosing tablets (that temporarily dye areas of dental plaque) to reveal toothbrushing effectiveness, walking through the typical daily activities of a toddler in visual story form and demonstrating how each activity relates to caries formation.

Table 1: Overview of Final Curriculum Topics

Class Session	Summary of Topics covered
Session 1	Introduction, goal setting, description and importance of baby teeth, process of cavity formation and overview of cavity prevention
Session 2	Details of how brushing with fluoride toothpaste helps prevent cavities, current tooth brushing technique, use of plaque disclosing tablets, demonstration and practice of ideal tooth brushing technique, demonstration and practice of dental floss technique, specific techniques for brushing children's teeth, lift-the-lip exam, behavior management and motivation for brushing children's teeth
Session 3	Details of the role of diet (types of food/drink, frequency, and bottle/sippy cup use) in causing and preventing cavities, how to transition away from the bottle/sippy cup, how to identify sugar in foods (nutrition labels) and healthy snack foods
Session 4	Details of the role of professional dental care in prevention and treatment of cavities, process of making appointments and attending dental checkup, overview of dental treatments (from prevention through restorations), dental behavior management techniques, making children feel comfortable at the dental visit, local resources, review game, certificates of course completion

Study participants received \$5 per class attended, and \$20 per survey for completing the baseline and immediate post-intervention survey and \$30 for completing a 3-month post-intervention survey as compensation for their time. Results presented in this report are about acceptability only; 3-month post-intervention data and their comparison with baseline or immediate post-test data about knowledge and practices are reported elsewhere. Questions in the pretest survey included demographic information, whereas questions in the posttest immediately after attendance at the fourth and final class asked participants about the degree to which they liked the classes using a five point Likert scale, and their favorite and least favorite activities using open ended questions. Surveys were administered in-person by Spanish-speaking research staff different from those involved in giving the classes. Open-ended questions were categorized, and responses to close-ended questions counted. Data were entered into a Microsoft Access database, with 10% of the data being double-entered by different researchers and checked for accuracy, achieving 100% agreement. Descriptive statistics were conducted using Stata 13.0. Attendance data was recorded by participants themselves on a sign-in sheet, and checked and revised by the *promotoras*.

Presented in the Results section are findings from the Phase 1 focus groups on acceptability of oral health education generally, acceptability of curriculum content, preferred activities and lesson format. Phase 2 results present survey data of acceptability of the fully implemented Contra Caries program. Participant quotes illustrate typical themes and comments in the data. When multiple speakers converse back and forth, interviewers and each respondent are noted using < >.

RESULTS:

Phase 1

Twelve focus groups were conducted ($N=51$). Participants were primarily mothers, though a few grandmothers, aunts, and one foster parent also participated. Participants were low-income, with on average a less than high school education (Table 2). The mean age of the child aged between 1-5 years, the focus of the educational intervention, was 3 ± 1.5 years; and 15% of children were parent-reported as having never been to the dentist. All lived in the rural community in which the study was conducted.

Table 2: Demographics for the Spanish-speaking caregivers in Phase 1 Focus Groups ($N=51$)

	% or Mean ($\pm$ SD)	Range
Caregiver Age (years)	31.4 $\pm$ 9	20-60
Caregiver is mother	88%	
Family size	4.3 $\pm$ 1.9	1-8
Annual Family Income*	\$19,000 $\pm$ 9,400	\$5,760-50,000 Median=\$16,800
Years Education	8.9 $\pm$ 3.9	1-17
Born Outside United States	90%	

* $n=29$ due to missing data, either “don’t know” or skipped question

Major results from the community focus groups that influenced the final content and format of the *Contra Caries* curriculum encompassed acceptability of: learning about children's oral health, *promotoras* as class leaders, curriculum content, and activities and lesson format.

Acceptability of learning about children's oral health

Participants were interested in learning about oral health for their children. Many had children with caries experience and were interested in preventing future tooth decay as well as understanding more about their previous dental treatment experiences. A common desire expressed by most participants was the importance of opportunities, such as education, available here in the United States compared to their life situation before immigrating. They were very interested and committed to provide improved opportunities for their children, as this mother explains:

“...It's very interesting for one to look at the progress of one's children and knowing that they are creating a better life for themselves than the one we've had. They have a lot of opportunities now to live a healthier life, not just in oral health, but physical health and everything, because now they have a lot of knowledge that we... well, I can say in my case, I didn't have. And yes, I lacked that, but now I give thanks to God for these new opportunities that we have to learn and to instruct our children to learn what we didn't have.”

To make classes work for parents' busy lives, they wanted classes in their neighborhoods in familiar and convenient locations, and for them to be conducted in Spanish. Stay-at-home parents preferred weekday mornings when older children were in school while working parents preferred evening or Saturday times. Providing free childcare during the classes was absolutely necessary for parents to be able to attend.

Acceptability of *promotoras*

Participants wanted *promotoras* who have “a good character and that you feel enough trust to express your point of view.” Participants preferred classes be taught in Spanish by women, particularly mothers who have experience raising and caring for children. These views were expressed in several focus group sessions:

<respondent2> I don't want to be a feminist, but I'd prefer a woman because women always have that thing of being a mother... more caring.

<respondent1> It's not just that, I think that we mothers are the ones that are on top of that, telling our children to brush their teeth... they have the experience. As a mother you are the one that makes them do more things than the fathers.

...

<respondent1> And they can give us their experiences that she had with her children, how she taught them and all that.

Acceptability of activities and lesson format

Participants preferred group class format where they could learn from each other, share their thoughts, and learn about experiences and thoughts of other caregivers. They strongly preferred the educational intervention to be given using the Spanish language, and liked pictures, illustrations and diagrams over written text. They preferred an interactive, rather than didactic educational format:

<respondent1> When a teacher is saying okay, and showing you the bulletin, ‘do this, do this, do this, do this,’ that doesn’t work. You aren’t going to catch everything in the same way compared to being in a group and we’re saying ‘okay, hold their mouth... this is this,’ and going over it so you-

<respondent3> Where you’d have more visual things.

<respondent1> Yes.

<respondent2> You are mentally catching it all because you are doing it and if you are just listening, your mind wanders.

<respondent3> Yes.

<respondent2> [thinking about] ‘I need to make dinner.’

<respondent3> That’s why I think it’s best for it to be more visual and entertaining to do.

Participants were less interested in written brainstorming or other writing activities:

<interviewer1> *And do you like to write your ideas or do you prefer to talk about them and not write?*

<respondent2> Well, I think it's better to talk because when you write you forget things, like what happened to me, and it's best to talk about them...

<respondent4> Yes, because at that moment our thoughts are coming to us and when you write you don't remember and think "what else can I put, what else can I put?"

<respondent2> Yes, it's best to just talk about it.

All of these suggestions were integrated into the revised, final curriculum. The content and sequencing of topics in the *Contra Caries* curriculum delivered during the pilot study appears above in Table 1.

Acceptability of curriculum content

As shown in Table 1, the draft curriculum proposed to cover topics such as the role of bacteria in caries and caries etiology, tooth eruption, tooth brushing for children, tooth brushing and flossing for adults, nutrition, using and stopping use of the bottle for infants, dental visits and cavity restorations. We asked caregivers what topics they would like to learn in class, and then to rank all the topics by priority. Particular topics around which participants had very strong opinions and engaged in considerable discussion helped to shape the final curriculum. This included information on how caries starts and progresses, weaning from the bottle, oral health care for adults, motivational strategies for children's tooth brushing, dental visits and dental treatments and restraints.

How caries starts and progresses

We asked parents whether we should include what caries is, the role of bacteria, and how the bacteria and disease progress with repeated exposure to carbohydrates/sugar along with lack of fluoride and poor hygiene practices. Parents felt this was an extremely important foundation for the rest of the classes and that this information needed to be presented first so that everything else could relate to this foundation. They helped develop a narrative thread, an analogy to which they related – that of protecting your house [teeth/mouth] from ants [bacteria] -- as a way to integrate the various topics, and to ensure the language of the lesson used familiar words and concepts and remained coherent and relevant to a low literacy audience.

Children using the baby bottle

Parents were unreceptive to suggestions based on the professional dental and pediatric literature of transitioning children from drinking from a baby bottle to a cup at 12-18 months old, the recommended age^[60]. They felt 12 months old was too young for a child to stop using a bottle and that 18-24 months was a more acceptable age. This excerpt from a focus group discussion illustrates this point:

<interviewer> Do you think [stopping the bottle] would work for children who are one year old?

<respondent1> It might be very early for them.

<respondent3> They would be very young. They don't understand yet.

<respondent1> Maybe a year and a half.

<interviewer2> *A year and half?*

<respondent1> I think so, because at that age [one year] they are very young, right?

<respondent3> Yes, a lot of the time when they are a year old and you want to talk to them, they don't pay attention to you, they don't understand you. So, you are going to be fighting with them over the bottle and they will want the bottle and they won't understand.

<respondent1> They are just starting to walk.

<respondent3> Yes. And you have to give them the bottle because the child won't understand and they are going to continue to cry and get desperate for their bottle and you'll say "be quiet". Yes, because I had that struggle with them. When they are older they get off it, but when they are a year old, that's very young.

Even with discussions of transitional techniques such as giving bedtime bottles with water, or cups of milk separate from bedtime, parents felt very strongly that children were not developmentally ready to stop drinking from a baby bottle at 12-18 months of age.

Oral hygiene for adults

Another topic area we debated including was oral hygiene for adults because the objective of the education intervention was for improving children's oral health. Parents, however, really liked learning how best to brush and floss their own teeth. For many, this was the first instruction on flossing they had ever had. They felt it was important for their health as well as for their ability to set a good example for their children to learn how to properly care for their own teeth. And once they learned about how caries-causing bacteria can be transmitted

between family members, they felt even more strongly that the instruction on adult hygiene had to stay in the curriculum. They liked the hands-on approach and in-class practice that the curriculum included, such as *promotora* demonstrations with large props depicting teeth, gums and brushing activity, and practicing in front of a mirror. They were comfortable using plaque disclosing tablets in a group setting. A few pregnant mothers chose not to participate in the disclosing tablet activity, due to nausea and uncertainty around the possible effect of the disclosing tablets.

Motivational strategies for children's tooth brushing

Participants expressed difficulty with overcoming the resistance of fussy children and with motivating their children to brush their teeth, because

“it’s difficult for them because, for one, you have to be telling them and a lot of the time with the breakfast, the house, the chores, or whatever, then you can’t be on top of everything”

and

“because it’s difficult for kids, especially when they don’t want to brush them at night... ‘I’m sleepy! I want to go to bed!’ So, that’s when you do your job as a parent, as a mother.”

Parents were very interested in techniques, strategies, and activities they could do with their children to improve tooth brushing cooperation. This was viewed as being especially important once parents learned the proper techniques and time required for optimal brushing. They shared and discussed many suggestions of successful techniques they themselves had used, as well as examples of struggles and failed motivational techniques. Favorite successful techniques were songs, taking turns, parent or sibling modeling, letting children select toothbrush or toothpaste with cartoons, letting children play with the water or toothbrush after brushing, and praise.

Dental visits

Despite most participants having children with dental restorations, few received (or remembered getting) explanations from child's dentist at that time. As these caregivers explained, "because they [dentists] don't really explain well about what they are going to do, how they are going to do it and the consequences that there are going to be." Caregivers wanted to learn about their rights at the dental office, and when it is acceptable to ask questions and for more information. This discussion illustrates these points:

<respondent 4> [I want to learn about] the dental office. I understood that we have the right to get information or ask them [questions] and that they answer what we want to know about the treatments and about things... about everything to do with our children's dental care, to have information that we would like to know...

<interviewer2> *Good. Okay.*

<respondent4> There are places that have people who don't want to help us or give us information.

<respondent3> And you are left with questions.

<respondent4> Yes. And I think that when it comes to everything about doctors and all that, I think that they should have that... give us information or answer our questions about why we are there.

Dental treatments and restraints

Parents wanted very detailed information not just about what exactly was happening during the decay process but also what the corresponding dental treatment was. They wanted, for example, to know not just formal terms but exactly what a filling is, how it differs from a crown, and when a child might need one or the other, as explained here:

<respondent5> When to know when a filling or crown is necessary.

<interviewer2> *Okay. Good.*

<respondent2> When is it okay to put those teeth, those ones they put when they have cavities, the silver ones at the front, are they silver?

< interviewer2> *When is it necessary, or at what age?*

<respondent3> When they need to be put.

<respondent2> ... what age they should put those on their teeth.

<interviewer2> *Cap them?*

<respondent2> Yes, because they put those on my son when he was two. He was very young and they didn't explain what exactly they were going to do. When it came out that

they had done that, he came out with marks from having his mouth open... marks on his face. We thought it was something more simple, but it wasn't.

<respondent3> They didn't explain what they were going to do?

<respondent2> No.

Participants also wanted a lot of detail around behavior management techniques some dentists use, such as what they called "tying down" (i.e., use of a "papoose board" or other physical restraint) and sedation. These were areas of high anxiety for caregivers. Because many times parents were not allowed into the treatment rooms during their children's dental treatments, they wanted to know what was happening to their children in the dental operatory, as this excerpt from the focus group explains:

"He was about four years old when they had to pull out his two front teeth, and they didn't explain that to me either. He came out... with a lot of marks, but too much... on his face, and on his arms, maybe because it was tight, but they didn't explain that. They just said that there was going to be some anesthesia and that he would be slightly drowsy, but that's it. And they didn't tell me that I couldn't be there either. I wanted to go in but they told me that I couldn't be there. They never told me that I couldn't be there and that they were going to tie him up so that he doesn't move, or that they were going to put something on him."

Phase 2: Post-test Survey Acceptability Questions

The implementation of the *Contra Caries* educational program involved 104 participants.

They were mainly Mexican-born mothers and about half had graduated high school (Table 3).

Table 3: Demographic Characteristics of low-income Spanish-speaking parent or caregiver and their child closest to 3 years in Phase 2, delivery of educational intervention (N=104)

Caregiver Characteristic	Count (%) or Mean $\pm$ SD; median; range
Mothers	80 (77%)
Caregiver birth country	
U.S.	11 (11%)
Mexico	90 (87%)
Age (years)	33.8 $\pm$ 8; median=33; range=18-57
Years completed in School*	
6 years or less	33 (32%)
7-11 years	18 (18%)
High School diploma	32 (31%)
More than High School	20 (20%)
Number of children	2.4 $\pm$ 1.1; median=2; range=0-5
Child Characteristic	Count (%) or Mean $\pm$ SD; median; range
Female	46 (44%)
U.S. Born	101 (97%)
Never had dental visit	14 (14%)
Age (years)	3.2 $\pm$ 1.3

* n=102

A total of 104 participants attended the *Contra Caries* Educational Program, with 83 completing the posttest survey with acceptability questions immediately after the last of the 4 educational sessions (12 other people (95 total) filled out the posttest survey, but the first version did not include acceptability questions). Thirteen classes were held, with between 5 and 14 students in each class (mean 7.7). Each session took two hours, with classes held on weekdays, mainly in the mornings and a few in late afternoons. Despite asking people, especially parents with young children, to commit to attend a class at a set day and time for four weeks in a row, attrition was low. Overall, the retention rate was 91%, with 89% of participants attending all 4 sessions, and only 5 people missing more than 1 session. Reasons for missed sessions were illness of participant or one of their children, or work schedule conflicts. Most people who missed a session arranged to attend other classes to make up sessions. A strong majority (95%) of respondents said they liked the class very much, 2 (2%) participants said they liked it a little, and 2 (2%) said “so-so”. No participants reported not liking it very much, or not liking it at all.

Participants were asked an open-ended question about their favorite class activity, allowing compound answers. The most commonly mentioned favorite class activity was learning the specific steps to brushing teeth, with about half of participants (53%) listing tooth brushing generally, or a specific aspect of tooth brushing instruction such as how long to brush for, or how to hold or move the toothbrush. Six parents specifically mentioned valued aspects of instruction related to managing children, such as using dolls as learning models, or tactics to motivate children’s interest and cooperation in brushing (e.g., singing). The next-most popular class activities were flossing (16%), all activities (16%), a review game covering all topics (11%), sugar and nutrition labels (10%), and decay process (9%).

Open-ended questions were also asked about class format. Class size was a common topic of both satisfaction and dissatisfaction (some wanted larger class sizes more like school classes, and others wanting smaller more intimate sizes). But the familiar, convenient location and time of class were listed often as things liked about the class, as was the sharing and social nature of the activities, and the use of *promotoras* as the educators.

DISCUSSION

This study found that their children's oral health is a high priority for low-income Spanish-speaking parents. They were not only interested in, but actually regularly attended classes for parents focused on increasing their knowledge and skills with respect to early childhood oral health. *Contra Caries* content and format was perceived as highly acceptable.

Very little has been written about the acceptability of various children's oral health educational interventions, including those aimed at Latino families. Some research examined acceptability of various ECC prevention methods, including tooth brushing with fluoride toothpaste, and found it acceptable to parents^[36], but a formal educational platform of how to guide parents to conduct those prevention methods was not examined. Despite this lack of acceptability literature in oral health education specifically, *promotora*-based education is well-received in similar populations on other health-focused topics^[68-71]. While some *promotora* programs have been developed around oral health^[73], to our knowledge they have not previously been evaluated for acceptability.

Parents reported liking a group class setting with other parents, and preferred to be taught by lay people (*promotoras*) who had children over health education or dental professionals, consistent with reports of *promotora* interventions being acceptable to this population^[2]. Similar

to previous research with the Latino population that has reported low knowledge about the role of bacteria and sweet liquids in baby bottles as contributing factors to ECC^[22, 55, 58], prevention topics of particular importance to parents in this study included information on how caries form and progress, oral health care for adults, motivational strategies for encouraging children's tooth brushing or overcoming their resistance to this activity, issues that again coincide with previous research findings with similar populations^[33]. Evidence-based motivational strategies around tooth brushing techniques for children are not currently in the literature; current approaches will need further research. However, research demonstrating that maternal self-efficacy has a role in children's oral hygiene practices supports the idea that having specific strategies that increase parents' confidence to carry out children's oral hygiene could be beneficial^[72].

The desire for parents to receive information about adult dental health and details of dental treatment procedures, however, was new information not reported in previous research. This was reassuring since the literature on vertical transmission of cariogenic bacteria supports the inclusion of adult oral health education as a component in child-focused oral health interventions^[5]. This desire for education to apply to all family members is not surprising, given the well-documented cultural value of familism in the Latino population^[74].

Parents' strong desire to learn very detailed information about dental visits and cavity restorations is not noted in the literature. Differences in dental care between (migrant) parents' home country and the U.S., low utilization rates (and thus familiarity) with dental care for parents, language and health literacy barriers, and high dental need of their children resulting in extensive behavior management and advanced restoration techniques, could all be contributing factors to this expressed desire. In addition, very little data is available on acceptability of oral

health behavior management techniques, such as use of restraints or sedation, in the Latino population specifically, despite the significant caries burden in this population.

The issue of parents not agreeing with the professional guidelines that children be weaned from using the bottle at 12-18 months of age is consistent with literature reporting later weaning in this population^[75]. However, given the strong contribution of prolonged bottle use to dental caries, it is an area that warrants further, collaborative research to identify facilitators and barriers to timely weaning, and interventions or tools to equip and motivate parents to successfully wean their young children. Some preliminary comparative research identified early introduction of a cup and trust/communication with health providers as some characteristics of Latino families who were able to wean their children from the bottle at an earlier age^[76].

Finally, survey results after participation in the *Contra Caries* program reinforce initial findings from the focus groups—this topic and format is of interest to parents, and 95% of participants enjoyed the *Contra Caries* program “very much”. 91% of participants who started the program continued attending.

Like all research, this study has limitations. Social desirability bias is definitely a potential factor to consider, especially with survey answers after the intervention. Participants may have been hesitant to criticize the program, although we attempted to mitigate this by having research staff and not the *promotoras* from the classes administer the survey, and having researchers emphasizing an interest in receiving negative feedback. Both phases of this project used a convenience sample recruited from community services and housing, who may have been more motivated, more connected to services, or different from the general population in important ways. These samples, however, matched well samples reported in other studies of low income Spanish-speaking parents and their views on children’s oral health, which suggests the

sample was reasonably representative of this population sub-group^[10, 22]. We made attempts to minimize potential bias from recruitment limitations through reaching out to a variety of community settings, for example in Phase 2 both daytime recruitment to apartment complexes to reach stay-at-home parents, as well as recruitment from a daycare who serves working parents. Whatever bias remained in our recruitment strategy limits the generalizability of our results, thus we caution readers that care should be taken when generalizing to Latinos with another socioeconomic status, geographic location, or migration history. Finally, participants were offered compensation for the time they spent participating in the intervention and research procedures. It is possible that this compensation inflated attendance rates, although we limited the payment per class attendance to only \$5.00 per class to attempt to limit this. Future, larger and randomized studies of the curriculum would be desirable in order to test efficacy of the curriculum at improving oral health related knowledge and behaviors, as well as the cost and benefit of widespread implementation of the program.

Conclusion:

Latino parents are interested and motivated to learn about improving their children's oral health. Important topics include how caries starts and progresses, adult and children's oral hygiene including motivational techniques for children, and dental treatments and restraints. The *Contra Caries* Oral Health Education Program was acceptable to low-income, Spanish-speaking parents of children 1-5 years and attendance, retention, and acceptability of the program were high. Participating in the curriculum development and revision process likely played an important role in the parents' high acceptability of the program. Additional research into efficacy and cost-effectiveness of the program is warranted.

Acknowledgements/Support:

A version of this chapter was previously published in BMC Oral Health.^[2] Coauthors include: Sarah M. Rios, Estela Pantoja Guzman, and Judith C. Barker.

This research was supported by the National Institute of Dental & Craniofacial Research of the National Institutes of Health under Awards Number 1R21DE019210 and F31DE023282. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

The authors thank study participants as well as the field team, community advisory board and staff from Community Oral Health Services. We also thank Jane Weintraub and Abby Alkon for input and consultation in drafting the original curriculum, the Center to Address Disparities in Children's Oral Health (CAN DO), *promotoras* Lorena De Guzman, Diana Rincon Ruiz, Yadira Rubio Valdez and Leonor Santos, and Robert Hiatt and Stephen Shiboski for reading and commenting on drafts.

Chapter 2: Effectiveness evaluation of Contra Caries Oral Health Education Program for improving Spanish-speaking parents' preventive oral health knowledge and behaviors for their young children

ABSTRACT

Objectives: To determine the effectiveness of the *Contra Caries* Oral Health Education Program (CCOHEP) for improving low-income, Spanish-speaking parents' oral health knowledge and behaviors for their young children. Mexican American children in the United States suffer disproportionately high prevalence and severity of early childhood caries, yet few evaluated, theory-based behavioral interventions exist for this population. CCOHEP is a theory-based curriculum consisting of four 2-hour interactive sessions designed for and by Spanish speakers and led by designated community health educators (*promotoras*). Topics included children's oral hygiene, caries etiology, dental procedures, nutrition, child behavior management and parent skill-building activities.

Methods: Low-income Spanish-speaking parents/caregivers of children aged 0-5 years were recruited through community services in an agricultural city in California. Survey questions from the Oral Health Basic Research Facts Questionnaire measuring oral health related behaviors and knowledge were verbally administered before, immediately after, and 3 months after attendance at CCOHEP. Five questions measured aspects of parental tooth brushing for their children (frequency, using fluoridated toothpaste, brushing before bed, not drinking or eating after nighttime brushing, adult assistance), three questions measured other oral health behaviors, and 16 questions measured oral health-related knowledge. Analyses of within-person changes

between pre- and posttests, and again between post-test and three month follow up consisted of McNemar's test for binary outcomes and sign tests for ordinal outcomes.

Results: Overall, 105 caregivers participated in CCOHEP ($n=105$ pretest, $n=95$ posttest, $n=79$ second posttest). At baseline, all parents self-reported doing at least one aspect of toothbrushing correctly, but only 13% reported performing all five aspects according to professional guidelines. At posttest, 44% of parents reported completing all aspects of tooth brushing according to professional guidelines ($p<.001$). Statistically significant improvements were seen in 4 aspects of toothbrushing ($p\leq.008$) between pretest and posttest (all but adult assistance). The second posttest showed 3 of these improvements were maintained, while adult assistance and the other reported behaviors improved ($p\leq.008$). Between pretest and posttest, checking child's teeth monthly and frequency of sweet drinks consumption improved ($p\leq.008$) while frequency of eating sweet foods did not change. Knowledge was high at baseline (mean 12.83 of 16), but 6 knowledge items improved significantly between pretest and posttest. Improvements were maintained at second posttest.

Conclusions: CCOHEP improved low-income Spanish-speaking parents' oral hygiene knowledge and self-reported behaviors for their young children, and change was sustained 3 months after the end of the intervention. Future, more rigorous evaluation of the intervention is recommended.

INTRODUCTION

Early childhood caries (ECC) is tooth decay of the primary dentition in children 71 months of age or less^[3]. Left untreated, it is a chronic and painful condition affecting quality of life and interfering with child's ability to perform necessary daily activities such as eat, sleep, talk, learn and play^[19, 77, 78]. It also can affect speech, self-image, and put children at higher risk for dental problems later in life^[19, 20, 78, 79]. ECC affects 24% of all 2-4 year old children in the United States (U.S.)^[80]. Among low income families, however, 43% of low-income Mexican American children experience ECC, over 9% more than low-income non-Hispanic white and black children^[80]. Mexican American children also have more severe, extensive and untreated decay^[77]. Though progress has been made in decreasing prevalence of dental caries generally in the United States, this youngest age group has witnessed an increase in ECC prevalence in recent years, with low-income children suffering higher increases than those in the general population^[8, 80, 81]. Although rural/urban differences in ECC in nationally representative samples have not been studied, small localized studies of rural Mexican American and Latino populations have found very high prevalence of ECC, including high burden of untreated ECC^[10, 15-17].

While it is well established that Mexican American children suffer from a larger burden of ECC, very little has been firmly established about what causes the disparity between them and non-Hispanic white and black children. Small studies in single locations with heterogeneous Latino populations have found some factors affecting Latino children under age 5 years to be: parental knowledge, oral hygiene habits like brushing with fluoride toothpaste, dental care utilization, mother's untreated caries status, and child cooperation while brushing, though few studies exist comparing these factors to non-Hispanic white or black groups^[12, 31, 32, 82-84].

While ECC is caused and sustained through a wide variety of factors, it can be prevented or ameliorated through modifiable behaviors, including twice-daily toothbrushing with fluoride toothpaste, establishing regular dental care by age 1 year, preventive care like fluoride varnish, and consuming diets with a low frequency of sugar-containing snacks and drinks^[7, 27, 60]. However, in two small studies of low-income Latino populations, nearly half of Latino 2-year olds did not meet this toothbrushing recommendation^[31, 32].

Few oral health interventions exist targeting low-income Spanish-speaking parents of young children^[49, 50]. Moreover, very few have been evaluated or theory-based^[51-53]. While motivational interviewing is one educational approach that includes parents and has shown promising results in both behavior change and caries prevention, it has not been extensively evaluated for Spanish-speaking populations.^[85, 86] Oral health promotion programs for children generally are not culturally or linguistically specific for Latino or Mexican American populations; tend to target older children through schools and preschools; and rarely include parents/caregivers in their education program^[38, 50, 54]. Yet parents/caregivers are important for children 5 years and under, as it is the parent who primarily manages the child's diet, supervises their behavior, undertakes oral care practices and seeks professional dental services. For example, Douglass and colleagues found that children who had parents assist in brushing their teeth had lower prevalence of caries than children whose parents did not assist^[31].

Contra Caries Oral Health Education Program (CCOHEP) is a curriculum for Spanish-speaking parents of children up to five years of age, consisting of 2-hour participatory/interactive sessions led by lay people trained as *promotoras* or community health outreach workers. Four people with parenting or childcare experience were hired as *promotoras*, and were trained primarily using CCOHEP itself, including more in-depth oral health detail so that

they could field likely questions, as well as be proficient at group facilitation, study-specific procedures and ethics. CCOHEP was designed around the constructs in Bandura's Social Cognitive Theory which addresses personal, social and environmental dimensions of behavior such as self-efficacy which has been shown to be related to maternal tooth brushing behavior for their children.^[43, 87] For example, the second session that focused on oral hygiene topics consisted of several items, described here along with a parenthetical note of where/how they fit with the theoretical model. These items are: explanation of how toothbrushing with fluoride toothpaste prevents cavities using both a biomedical explanation and the analogy of protecting your house from ants (these being outcome expectations); participants using disclosing tablets to brush their own teeth; demonstration of proper brushing and flossing technique and materials for adults and children using models (observational learning, situation); demonstration and practice of positions to brush a child's teeth including giving feedback to a partner (observational learning and behavioral capability); practice flossing on a model (behavioral capability); "lift the lip" exam: discussion of behavior management and motivational techniques for brushing children's teeth including group sharing and trouble-shooting to help parents be able to brush children's teeth under challenging circumstances (emotional coping response, self-efficacy); setting toothbrushing goals to revisit at the next class (self-control); and, providing participants with toothbrushes and fluoridated toothpaste for all family members (environment). The target population participated in curriculum development and provided feedback to refine content and activities.^[2] The curriculum aims at increasing parents' knowledge and skills using various didactic approaches as well as skill-building through diverse activities. *Contra Caries* consists of four sessions: 1- caries etiology and reducing germ sharing, 2- parent-assisted toothbrushing with fluoride toothpaste, flossing, and child behavior management during toothbrushing, 3- reducing

sugar intake, snacking, diet, and bottle use, and 4- the tooth decay process, fluoride, and how to initiate and what to expect during dental visits. Classes are designed to (a) provide an understandable rationale for parents about why toothbrushing and other protective behaviors matter for young children and (b) to collectively lead to improved quality and quantity of oral hygiene. Development, details of content and acceptability of the curriculum are reported elsewhere^[2].

The objective of this paper is to determine the effectiveness of the *Contra Caries Oral Health Education Program (CCOHEP)* for improving Latino parents' oral health related knowledge and self-reported behaviors for their young children both immediately after attendance at the educational intervention as well as three months after completion of the intervention.

METHODS

This study employed a single group, pre- post- test design. A pretest was administered at baseline, followed by a month-long intervention, an immediate posttest (Posttest1), and a second posttest (Posttest2) four months after baseline (3 months after completion of the intervention) (Figure 1). All study procedures are in full accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) and were reviewed and approved beforehand by the Institutional Review Board at the University of California, San Francisco (Approval number 11-05603). The study was undertaken with the understanding and written informed consent of each adult participant.

Data collection took place in an agricultural city with a population of 150,498, in northern California^[88]. Approximately 75% of the city's population is Hispanic, and 68.5% speak a language other than English at home. The city does not have optimally fluoridated tap

water. The median income is \$49,264, with 21% of the city population below the federal poverty line.

Recruitment lasted from August through December of 2011. Individuals were enrolled in a rolling fashion into intervention class groups with a goal of having 10 to 14 parents in each class, and at least 8 classes in total. Each class received the same four-session curriculum. Each of the four *promotoras* was scheduled to lead at least two classes. Posttest2 surveys were administered through March 2012. Participants received a \$20 grocery store gift card for each Pretest and Posttest1 survey, and \$30 for Posttest2 survey. They also earned a \$5 gift card for each session they attended (maximum \$20 for complete attendance), distributed after the final session.

Participants were parents or caregivers of a child aged 0-5 years, recruited through flyers or personal contacts through community services such as the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), migrant farmworker daycare services, and low-income apartment complexes. Participants were usually mothers, but some fathers, grandparents, babysitters or foster parents participated as well. No sample size calculation was used to inform the sample size, as no existing effect size data was available and there was only a modest budget with which to carry out the research. Rather, a target sample size of 100 participants was decided on, based on the largest number that the pilot study budget would allow and the number of participants who could be recruited and finish classes in the timeframe of the study.

Inclusion criteria included: adult, aged 18+ years; self-identification as Hispanic or Latino; Spanish-speaking; low-income ($\leq 200\%$ US 2011 federal poverty level); plan to live in the study city for next 6 months; parent or caregiver for a child aged 0 to 5 years.

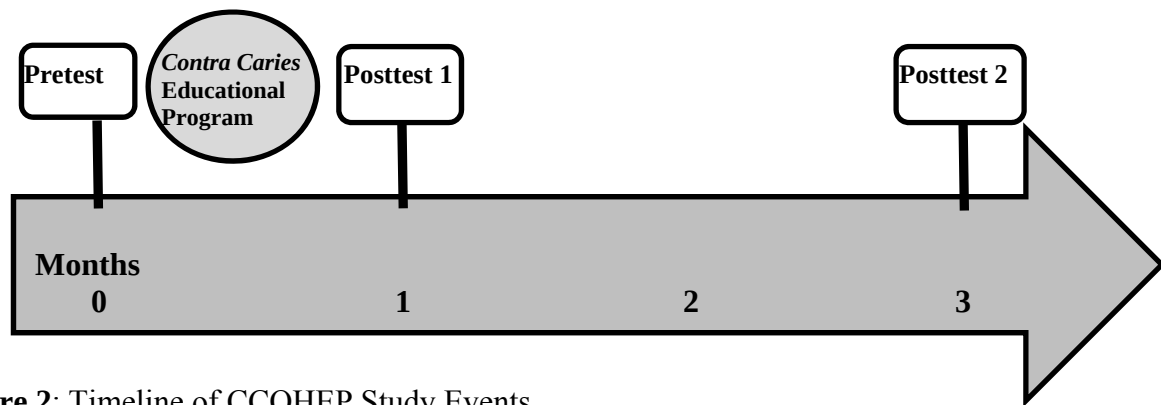


Figure 2: Timeline of CCOHEP Study Events

Questionnaires were verbally administered before and after attendance at CCOHEP (baseline and 1 month after baseline), and again 3 months after completion of the CCOHEP (4 months after baseline) (Figure 2). Questionnaire administration was conducted by bilingual researchers, not the *promotora* leading the classes. Posttest1 questionnaires were administered immediately at the conclusion of the class or if participants couldn't stay after the final session, were scheduled individually at the study office or individual's homes within a few days of the end of the class. Follow-up between Posttest1 and Posttest2 was done through phoning and texting individual participants 2 months after classes ended to remind them we would like to meet with them in 1 month. At the 3 months point after their class ended, participants were again phoned or texted to schedule the final data collection appointment in the study office, participant's home, or at a community location such as WIC, a park, or an apartment building's common room.

Questions included demographic characteristics for the caregiver and their child. If there was more than one child under age 5 years in their family, we asked the participant to respond about the child closest to age 3 years. Questions about oral health knowledge and self-reported

behavior, taken from the Oral Health Basic Research Factors Questionnaire (BRFQ), measured aspects of ideal toothbrushing behavior for children's teeth (5 questions: frequency of daily brushing, using fluoridated toothpaste, brushing before bed, no drinking/eating after nighttime brushing, adult assistance); behaviors around dental visits and diet (3 questions); and knowledge around oral hygiene causes and prevention measures (16 questions).

Questions were coded in a binary fashion, as either meeting the behavior or knowledge recommended by the American Academy of Pediatric Dentistry (AAPD), or not^[60]. A summary score was created by summing 5 aspects of toothbrushing, with one point given for each recommended behavior resulting in a maximum score of 5; and a binary variable representing correctly doing all 5 aspects of toothbrushing was also established. Data were entered into a Microsoft Access database. Then 10% of the questionnaires were randomly selected to be double entered, comparison showing 100% agreement between the two data entries.

Analyses of within-person changes between pre- and posttest1 (initial change), as well as between posttest1 and posttest 2 (delayed change or maintenance) were based on McNemar's test for binary variables, t-test for continuous, and sign test for ordinal categorical variables. We also used logistic and ordinal logistic regression models to evaluate the association between demographic factors and the following outcomes: a binary indicator of correctly performing all 5 aspects of toothbrushing behaviors at baseline, an ordinal measure of whether behavior change was observed, and a binary indicator of loss to follow-up. Stata 13 Software was used for all analyses^[89].

Questionnaire knowledge items answered as "don't know" were coded as an incorrect answer; "don't know" behavior items were excluded from analyses for that question. To assess the possible impact of loss to follow up on results, we compared distributions of demographic

variables between individuals who stayed in the study, and those who were lost to follow up. We also assessed results based on imputed responses using the following two procedures: setting missing responses to the corresponding previous value, and also setting all missing responses to baseline values, to reflect expected results if participants lost to follow up did not exhibit changes in knowledge or behavior.

RESULTS

We reached the target number of parents/caregivers in CCOHEP, allowing five extra enrollees ($n=105$ pretest, $n=95$ Posttest1, $n=79$ Posttest2). The 105 participants enrolled in the study were divided into 13 classes, with a mean of 7.7 participants per class at baseline (range 5-14). The rate of attrition between surveys was low (10 people did not take Posttest 1 (90% retention from baseline) and 26 did not take Posttest2 (75% retention from baseline); and there were no differences in baseline toothbrushing behaviors, parent age, parent education level, child age, child gender or child birth order between those who stayed in the program and those lost to follow up. A majority (89%) of participants had perfect attendance, attending all 4 class sessions, and those who missed classes reported it due to being sick or having a sick child. Details of the format and procedures during sessions and reasons for non-attendance or drop-out are provided elsewhere^[2]. Study participants were mainly Mexican-born mothers with high school or lower education, caring for predominantly US-born children (Table 4).

Table 4: Self-Reported Demographic Characteristics of Low-Income Spanish-Speaking Parent or Caregiver and their Child Closest to 3 Years of Age (N=105)

Caregiver Characteristic	Count (%) or Mean $\pm$ SD; median; range
Mothers	81 (77%)
Age (years)	33.7 $\pm$ 8; median=33; range=18-57
Caregiver birth country	
U.S.	11 (10%)
Mexico	91 (87%)
Other	3 (3%)
Years living in the U.S. if foreign born (n=94)	12.3 $\pm$ 6.6; median=11; range=3-31
Years completed in School	
6 years or less	35 (33%)
7-11 years	18 (17%)
High School diploma	33 (31%)
More than High School	19 (18%)
Self-rated oral health	
Excellent	3 (3%)
Very Good	3 (3%)
Good	19 (18%)
Average (translated as “regular”)	53 (50%)
Bad	27 (25%)
Number of children in household	2.4 $\pm$ 1.1; median=2; range=0-5*
Child Characteristic	
Age (years)	3.0 $\pm$ 1.3; median=3; range=0-5
Female	47 (45%)
U.S. Born	102 (98%)
First born child	38 (36%)
Never had dental visit	14 (13%)
Received fluoride varnish in past year	50 (48%)
Currently take fluoride supplement*	12 (18%)†
Child stopped using a baby bottle before age 2 years‡	29 (31%)‡
Caregiver-rated child oral health	
Excellent	14 (13%)
Very Good	10 (10%)
Good	44 (42%)
Average (translated as “regular”)	35 (33%)
Bad	2 (2%)

This table adapted from Table 3 in Hoeft et al BMC Oral Health^[2]

* Caregivers with zero children were grandparents or childcare providers who did not have children under 5 of their own, but cared for such children regularly

† n=65 for the question about fluoride supplements, due to poorly followed skip pattern in the survey

‡ n=94; (9 children under age 2 still using the bottle)

At baseline, 13% of participants self-reported performing all 5 toothbrushing behaviors correctly; the average number of correct behaviors was 2.6 ± 1.6 . Data from the five aspects of toothbrushing are reported for all three timepoints in Table 5. The most commonly reported behaviors were brushing child's teeth twice a day (82%) and using fluoridated toothpaste (86% of those who brushed). The least reported behavior was brushing the child's teeth before bedtime every day in the last week (22%). At baseline, there were no significant differences in parent age, parent education level, child gender or child birth order between those participants who reported all 5 toothbrushing behaviors, and those who didn't ($p > 0.1$). For toothbrushing frequency at baseline, however, child age mattered: parents reporting about children one year old or younger were less likely to report brushing their child's teeth twice daily than were parents of older children ($p = 0.018$).

Table 5: Self-Reported Toothbrushing Behaviors at Baseline and Two Follow-Up Points

	Pretest (Baseline) (N=105)	Posttest1 (1 month) (n=95)	Posttest2 (4 months) (n=79)	Within- person change between Pretest and Posttest1	Within- person change between Posttest1 and Posttest2
TOOTHBRUSHING BEHAVIORS					
Average number of correct behaviors	2.6 ±1.6 n=105	4.2±0.9 n=95	4.6±0.6 n=71	↑ [*] p<0.0001	↑ p=0.0004
Performed all 5 toothbrushing behaviors correctly	14 (13%) n=105	42 (44%) n=95	47 (66%) n=71	↑ p<0.0001	↑ p=0.0033
Brush twice a day or more	84 (82%) n=102	94 (99%) n=95	69 (90%) n=77	↑ p<0.0001	→ p=0.7815
Brush with fluoridated toothpaste	69 (86%) n=80 additional 21 (20%) answered “don’t know” and were excluded	92 (96%) n=95	75 (99%) n=76	↑ p=0.008	→ p= 0.5637
Brushed child’s teeth before bed every day last week	22(22%) n=100	78 (82%) n=95	60 (81%) n=74	↑ p= 0.0001	→ p= 0.7963
Child does not eat or drink anything after brushing his teeth and before going to bed	47 (47%) n=100	76 (80%) n=95	60 (92%) n=74	↑ p<0.0001	↑ p= 0.0076
Adult assistance with brushing child’s teeth every night	55 (57%) n=96	64 (67%) n=95	70 (95%) n=74	→ p=0.2568	↑ p= 0.0001

*arrow symbols denote the direction and significance of the change:

↑ Statistically significant improvement

→ No statistically significant change

Results from Posttest1 (immediately after completion of CCOHEP, 1 month after baseline) showed 44% of participants reporting performing all 5 toothbrushing behaviors correctly, and the average number of correct behaviors was 4.2 ± 0.9 . Of participants with less than perfect scores at baseline, 79% improved at least one behavior between baseline and Posttest1. McNemar's test for pairwise comparison examined within-person change between Pretest and Post1, assessed initial changes from the intervention, and found 4 of the 5 reported toothbrushing behaviors showing statistically significant improvement between Pretest and Posttest 1. Only adult assistance with brushing child's teeth every night did not statistically improve between the first two timepoints.

McNemar's test was used again between Posttest1 and Posttest2, assessing whether initial changes were sustained, further improved, or were lost over the three months after the intervention. The change between Posttest1 and Posttest2 is not statistically significant for the first 3 of the 5 reported behaviors, indicating sustained changes between the two time points. These three behaviors are brushing the child's teeth twice a day, using fluoridated toothpaste, and brushing before bed every night in the previous week. There are statistically significant improvements for the last 2 reported behaviors, not eating or drinking after brushing but before going to bed and adult assistance with brushing child's teeth every night. This latter behavior hadn't initially improved at Posttest1. These changes are also illustrated in Figure 3. Results did not change when missing values were recoded as the last value.

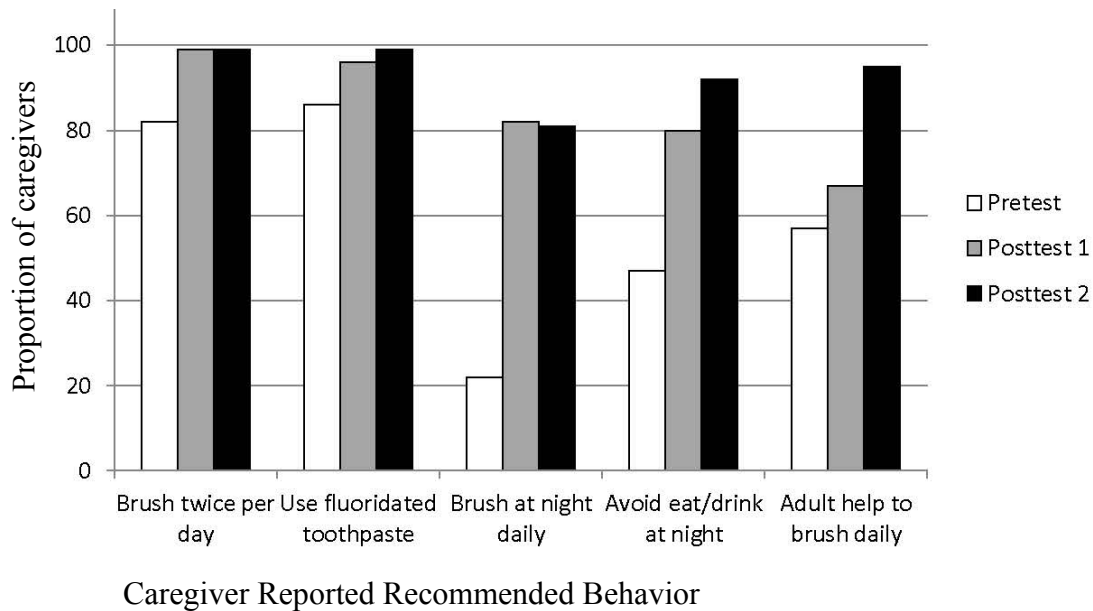


Figure 3: Comparison of Proportion (%) of Parents Reporting Performing AAPD Recommended Oral Hygiene Practices for Their Young Child between Pretest, Posttest1, Posttest2

Results for other reported oral health behaviors - monthly checking of child's teeth and mouth ("lift the lip"), frequency of drinking sweet drinks, and frequency of eating sweet foods- are reported in Table 6. The number of caregivers who reported performing "lift the lip" monthly significantly increased between baseline and Posttest1, and was then maintained to Posttest2. Drinking of sweet drinks once a day or less also significantly improved in a positive direction between baseline and Posttest1, from one-third to 77% of participants, but then decreased non-significantly between Posttest1 and Posttest2 to just under two-thirds (63%). The number of caregivers giving their children sweet foods less frequently than every day, did not change significantly across the three time points: just under one-half the sample reported this behavior at all 3 time points. Thirteen children were using a bottle at baseline, and only 3 of these children managed to stop using the bottle by the end of the evaluation period (two at Posttest1, and one at Posttest2). The three that stopped were the oldest of the thirteen, two were

aged 3 years and one was aged 2 years 8 months. Of the 10 who continued using the bottle, two were just over two years of age at baseline while the rest were under 18 months.

Table 6: Self-Reported Other Oral Health Behaviors at Baseline and Two Follow-Up Points

	Pretest (Baseline) (N=105)	Posttest1 (1 month) (n=95)	Posttest2 (4 months) (n=79)	Within- person change between Pretest and Posttest1	Within- person change between Posttest1 and Posttest
OTHER ORAL HEALTH BEHAVIORS					
Check the child's teeth each month ("lift the lip")	76 (75%) n=103	94(99%) n=95	72 (95%) n=76	↑ p<0.0001	→ p= 0.1797
Child ingests sweet drinks once a day or less	35 (33%) n=105	73 (77%) n=95	48 (63%) n=76	↑ p=0.0082	→ p= 0.1306
Child eats sweet foods less than every day	42 (40%) n=104	45 (47%) n=95	37 (49%) n=76	→ p= 0.2568	→ p= 0.8575

↑ Statistically significant improvement

→ No statistically significant change

Overall, knowledge was high at baseline, with an average baseline score of 12.8 ± 1.6 out of a total possible of 16 (Table 7). All caregivers knew that drinking soda is bad for children's teeth; children's teeth should be brushed twice a day; and sharing a toothbrush with your child is bad for their teeth. Almost all, 92% or higher, knew that it is necessary to go to the dentist at times other than when children's teeth have a problem; fluoride toothpaste should be used when brushing; checking children's teeth each month is good for their teeth; that eating or drinking something after brushing teeth but before going to bed was bad for teeth; and that caregiver brushing and flossing their own teeth was good for their child's teeth. These knowledge items stayed high at Posttest1 and Posttest2.

Table 7: Oral Health Knowledge at Baseline and Two Follow-Up Points

	Pretest (Baseline) (N=105)	Posttest1 (1 month) (n=95)	Posttest2 (4 months) (n=79)	Within- person change between Pretest and Posttest1	Within- person change between Posttest1 and Posttest
Total Knowledge Score	12.8±1.6 range=9-16 n=100	15.2±0.7 range=13-16 n=87	15.2±0.6 range=14-16 n=76	↑ p<0.0001	→ p=0.2983
Answered all knowledge questions correctly (score=16)	3 (3%) n=100	27 (31%) n=87	22 (29%) n=76	↑ p<0.0001	→ p=1.00
Drinking soda is bad for children's teeth	105 (100%) n=105	89 (100%) n=89	78 (100%) n=78	→ N/A	→ N/A
It is not necessary to go to the dentist unless children have a problem with their teeth (false)	102 (98%) n=104	88 (99%) n=89	78 (100%)	→ p=0.5637	→ N/A
It is best to use fluoride toothpaste to brush child's teeth	98 (93%) n=105	89 (100%) n=89	78 (100%) n=78	↑ p=.0082	→ N/A
Checking your child's teeth each month for changes or spots is good for their teeth	101 (96%) n=105	89 (100%) n=89	78 (100%) n=78	↑ p=0.0455	→ N/A
A child eating something after brushing their teeth is bad for their teeth	97 (92%) n=105	85 (96%) n=89	78 (100%) n=78	→ p=0.3173	↑ p=0.0455
Putting fluoride varnish on children's teeth is good for their teeth	79 (76%) n=104	89 (100%) n=89	78 (100%) n=78	↑ p<0.0001	→ N/A
Using a sippy cup at meal time doesn't affect a child's teeth	23 (22%) n=105	31 (35%) n=89	25 (32%) n=78	↑ p=0.0077	→ p=0.7316
Cavities are caused by bacteria in the mouth	78 (74%) n=105	89 (100%) n=89	77 (100%) n=77	↑ p<0.0001	→ N/A

Table 7 continued:

	Pretest (Baseline) (N=105)	Posttest1 (1 month) (n=95)	Posttest2 (4 months) (n=79)	Within- person change between Pretest and Posttest1	Within- person change between Posttest1 and Posttest
Baby teeth are not very important because they don't stay in the mouth for long (false)	65 (63%) n=103	86 (97%) n=89	78 (100%) n=78	↑ p<0.0001	→ p=0.1573
Sharing a toothbrush with your child is bad for their teeth	105 (100%) n=105	89 (100%) n=89	78 (100%) n=78	→ N/A	→ N/A
Eating chips is bad for your child's teeth	83 (79%) n=105	87 (99%) n=88	78 (100%) n=78	↑ p<0.0001	→ p=0.2173
Using the same spoon to taste your child's food and feed them is bad for child's teeth	92 (88%) n=105	89 (100%) n=89	78 (100%) n=78	↑ p=0.0016	→ N/A
Drinking a sippy cup with milk at bedtime is bad for your child's teeth	69 (66%) n=105	85 (96%) n=89	78 (100%) n=78	↑ p<0.0001	→ p=0.7316
Brushing and flossing your own teeth is good for your child's teeth	104 (99%) n=105	88 (100%) n=88	78 (100%) n=78	→ p=0.3173	→ N/A
Age children can brush their teeth alone (age 6 years or higher coded as correct)	31 (30%) n=105	90 (95%) n=95	69 (87%) n=79	↑ p<0.0001	→ p=0.083
A child's teeth should be brushed at least 2 times a day	104 (100%) n=104	95 (100%) n=95	78 (100%) n=78	→ N/A	→ N/A

↑ Statistically significant improvement

→ No statistically significant change

Seven knowledge items were lower at baseline (between 30% and 88%), but all improved to 95% or above by Posttest1 and were maintained at Posttest2. These knowledge items were about: fluoride varnish being good for teeth; cavities being caused by bacteria; importance of baby teeth; eating chips being bad for teeth; using the same spoon to taste your child's food and feed them; using a sippy cup with milk at bedtime is bad for a child's teeth; and, the age at which children can brush their teeth alone. In particular, at baseline only 30% of parents knew that children should be at least 6 years old to brush their teeth independently; some (10%) even suggesting that children as young as 1 and 2 years could brush unassisted. Caregivers giving the correct age at Posttest1 rose considerably, to 95%, but fell slightly to 87% at Posttest2; explained by 9 parents who reported the correct answer only immediately after the intervention, reverting back to a lower number similar to their baseline response by Posttest2.

One knowledge item, that using a sippy cup with milk at meal time is neither good nor bad for a child's teeth, had the least number of correct answers at baseline (22%). While it improved slightly to 35% at Posttest1, it stayed quite low compared to all the other knowledge items.

Sensitivity analyses setting all missing values to the previous value did not result in any significant changes in findings. Setting missing Posttest2 values to baseline values did result in different findings for checking a child's mouth ("lift the lip") such that if all people missing at Posttest2 reverted to their original behavior of checking the child's mouth, only 88% would have been doing the behavior correctly at Posttest2, a decrease from Posttest1 ($p=0.0039$). For knowledge questions, the question about it being bad for a child's teeth to eat something after having their teeth brushed before bed, would not have improved significantly between Posttest1 and Posttest2 ($p=0.1797$), and the question asking about the age at which children can brush their

teeth alone would have decreased between Posttest1 (88%) and Posttest2 (74%) ($p=0.0017$). All other items were not affected by the sensitivity analyses.

Analyses to examine the difference in rates of reported behavior change found no significant differences in toothbrushing behavior change or knowledge change by caregiver age, caregiver education, child age, child gender or child birth order.

DISCUSSION

The *Contra Caries* Oral Health Education Program successfully carried out 13 classes of 4 sessions each, retaining 90% of participants throughout the month of the class. CCOHEP was effective at improving low-income Spanish-speaking parents' oral hygiene knowledge and behaviors for their children under age 5 years. At baseline, only 13% of parents self-reported providing optimal toothbrushing behaviors for their children, despite scoring high on oral health knowledge measures. Immediately after attending CCOHEP, however, optimal caregiver-reported behavior performance improved to 44%, and 3 months after attendance, rose to 66%.

Four of the five reported toothbrushing behaviors improved between Pretest and Posttest1, especially brushing at night. And all 5 behaviors had improved by the three month follow up. The one behavior with limited improvement between baseline and the first follow up was adult help with brushing. The need for adult help with brushing every day was little known or performed at baseline; and posttests revealed this to be a difficult behavior for parents to improve, despite skill-building activities and discussion in CCOHEP classes, especially to improve to daily assisting rather than just occasional help. It is possible that this behavior competed with life demands, schedules, or was a low priority for parents to change^[33]. Seven

parents improved the frequency of adult assistance from never or “sometimes” to “most of the time” between baseline and Pretest1 but did not achieve the optimal “all of the time” measure used in these analyses. Recent work by Benadof and colleagues describe the stages of children learning how to brush their teeth including a “Stage 3: road to tooth brushing independence” which includes alternating between independent brushing by the children and parent-assisted brushing, this pattern of intermittent parent assistance is something that increased after participation in CCOHEP, but was not captured in the dichotomous variable of the AAPD guidelines^[90]. Another interesting component of this reported behavior was that 11 parents who reported assisted brushing at baseline subsequently reported not assisting their child with brushing at Posttest1. Previous qualitative research with Mexican-origin fathers in rural California found that they perceived themselves to be helping and supervising their children brush their teeth by only reminding them to brush—not actually physically assisting them^[37]. It is possible that these 11 parents who no longer reported assisting their children’s toothbrushing had that same assumption at baseline and thought they were helping their children brush, but once they learned through *Contra Caries* that children need actual physical assistance rather than simple reminding, they changed their answer at Posttest1, suggesting that their baseline answer should also have been that they don’t assist their children with toothbrushing.

Other reported oral health behaviors of checking a child’s teeth monthly, and drinking sweet drinks once a day or less improved from Pretest to Posttest1, and were maintained thereafter. However drinking sweet drinks only improved to 77%, showing an area that could use further intervention or reinforcement. This low improvement, as well as no reduction in frequency of daily consumption of sweet foods, is not surprising given how difficult it is to change dietary behaviors. Likewise, the limited change in reported bottle use, with few people stopping bottle

use by the recommended age of 18 months, matches previous comments from a similar population about the age parents perceive it to be acceptable for children to discontinue using a baby bottle^[2].

Knowledge was generally high at baseline, in line with previous reports that despite this population having high caries prevalence, they have high basic knowledge about the detrimental effects of sugar consumption and that brushing teeth can improve oral health^[55, 58, 83, 84]. The more nuanced areas of knowledge that were lower at baseline - such as knowledge about fluoride varnish being good for teeth, cavities being caused by bacteria, baby teeth being important, eating chips being bad for teeth, it being bad to use the same spoon to taste your child's food and then feed them, using a sippy cup with milk at bedtime being bad for a child's teeth, and the age at which children can brush their teeth alone – were also similar to previous research with similar low-income Spanish-speaking Latino populations. This suggests that such populations generally may not have detailed knowledge around how caries are formed and perpetuated^[58]. These complex areas of knowledge not only improved but were maintained after participation in the *Contra Caries* program.

Promotora interventions are usually quite acceptable, including for CCOHEP^[2], and having Spanish-speaking lay people from their own community be the one leading CCOHEP classes in a peer education approach allows for high cultural sensitivity and draws on the value of community, likely resulting in increased attendance, retention and a comfort in the setting. This might have been especially important with respect to being able to ask questions that they may not have felt comfortable asking in the dental clinic. However, outcome results of *promotora* education programs are sometimes mixed, though some have proven effectiveness^[91, 92]. This study adds to the literature demonstrating that *promotora* interventions can be effective as well

as acceptable. *Promotora* interventions have occasionally been used for oral health, but this is the first effectiveness study of such an intervention. As Latino children continue to exhibit poorer oral health than their non-Hispanic white and black counterparts, the *promotora* health education model is gaining popularity. Having available a promising, evaluated curriculum like CCOHEP is valuable to those community organizations and public health agencies looking to improve health disparities for this vulnerable population.

There are some components of CCOHEP that are similar to motivational interviewing, such as individuals selecting their behavior change goals and providing participant-driven education^[86]. However, CCOHEP includes a social support and group setting that participants particularly liked; this is typically absent in motivational interviewing because it usually has an individual focus.^[2] More examination of the mechanisms of action in both motivational interviewing and CCOHEP and their overlap is warranted.

This study is limited by lack of a control group, but within-person comparisons help reduce threats to validity. The major threat to this analysis is social desirability bias, in that parents who were exposed to the classes might have learned the correct answers (behaviors) from the class and reported those learned answers, but might not have been able to fully execute them at home. There is no way to know for sure if reported answers in the post-tests reflect actual behaviors or perceptions of desired behaviors. We attempted to minimize the latter by expressing the importance of honesty when filling out the questionnaire, having separate research staff unrelated to the *promotora* educators collect survey data, and using within-person change scores which minimizes the risk of confounding from individual characteristics.

Additional possible threats to validity include maturity (child development), history, and testing^[93]. Although the one month delay between baseline and Posttest 1 is unlikely to be long

enough for major child development to occur, the three month period between Posttest1 and Posttest2 is more likely affected by development and warrants further exploration in future studies, especially for behaviors like parent assistance with toothbrushing^[93]. Another possible concern is that the incentives provided (\$5 per session, and \$20 or \$30 per survey) could have been coercive. However, these low amounts have not previously been coercive.

Attrition was also a potential issue: 10 participants (9.5%) were lost to follow up between Pretest & Posttest1, and 16 (16.8%) lost between Posttest1 and Posttest2. This is lower than in other evaluated interventions^[51, 52], however, and sensitivity analyses showed that there would be no significant differences if missing participants scored the same as their previous value. If missing participants only scored their baseline values at all subsequent follow-ups, there would have been lower Posttest2 performance on the behavior of checking a child's teeth monthly, and less improvement in two knowledge items, but the other improvements, including reported behavior performance, would still have been statistically significant, suggesting that loss to follow up was not a strong driver in our findings.

Children's caries and the oral health behaviors targeted by CCOHEP and examined in this study are shaped by many different social determinants.^[4, 94-96] CCOHEP was designed with an awareness of influences outside of an individual parent, the parent themselves, and the dynamic between the parent and child, and attempted to address all these levels of influence. However, longer follow-up study would have been helpful to determine if CCOHEP was enough to sustain these changes over the long term, especially as parents were back in the environments that shaped their original behaviors in the first place and further removed from CCOHEP.

Despite these limitations, this study makes a valuable contribution and is a key first step in evaluating a new intervention, providing initial data supporting future, larger evaluations of

CCOHEP. This study is one of the first effectiveness evaluations of an oral health education intervention targeting low-income Spanish speaking parents of young children.

Contra Caries Oral Health Education Program improved Spanish-speaking parent oral hygiene knowledge and caregiver-reported behaviors for their children aged 0-5 years. Findings support previous research that many parents have some basic knowledge about children's oral health, but that this knowledge lacks depth and detail and does not always result in the related health promoting behavior. This study provided more useful details in the practical application of oral health knowledge. CCOHEP can improve parents' detailed knowledge of complex concepts and health promoting behaviors in this vulnerable population, knowledge which can be absorbed and maintained. Further research with randomization, a control group and longer follow up is warranted.

ACKNOWLEDGMENTS

A version of this chapter was previously published in Journal of Community Dentistry and Oral Epidemiology.^[1] Co-authors are Barker JC, Shiboski S, Pantoja-Guzman E, and Hiatt RA.

This research was supported by the National Institute of Dental & Craniofacial Research of the National Institutes of Health under Award Numbers R21DE019210 (funded project development and data collection); F31DE023282 (data entry and analysis, manuscript writing); U54DE019285, U54DE019275, & U54DE019259 (Basic Research Factors Questionnaire or BRFQ - development of survey items) and by a REAC (Cox fund) grant from the University of California San Francisco. The content is solely the responsibility of the authors and does not necessarily represent the official views of the funders.

We thank the study participants; the field research team (especially Sarah M. Rios); Drs. Jane Weintraub and Abby Alkon for input and consultation in drafting the original curriculum; Darby Henry for assistance with data entry; the *promotoras* (Lorena De Guzman, Diana Rincon Ruiz, Yadira Rubio Valdez and Leonor Santos); community advisory board; staff from Community Oral Health Services in Monterey County, CA; and, the Center to Address Disparities in Children's Oral Health (CAN DO) at the University of California, San Francisco.

Chapter 3: Social cognitive theory and Spanish-speaking parents' preventive oral hygiene behaviors for their young children

ABSTRACT

BACKGROUND: Early childhood caries (ECC) disproportionately affects Latino children, and is a health problem that can be a substantial burden on children's quality of life. Behavioral theory, such as Bandura's Social Cognitive Theory (SCT), can be a helpful tool in understanding health related behaviors. Previous oral health literature has not examined constructs of the SCT beyond self-efficacy, and none has examined SCT constructs with Latino populations, a group at particularly high risk for caries. *Contra Caries* Oral Health Education Program (CCOHEP) is an oral health education intervention designed for low-income Spanish speaking parents of children up through 5 years of age to improve knowledge, skills and behaviors relating to their children's oral health. It was developed by incorporating constructs from SCT, community input, and results from formative qualitative research with low-income Mexican American mothers. This project explores SCT constructs in relation to low-income Spanish-speaking parents' oral health behaviors for their children's dental health, examines whether SCT constructs improved after attendance at CCOHEP, and whether changes in SCT constructs and behaviors were related.

METHODS: Surveys asking about recommended oral hygiene behaviors and SCT constructs around those behaviors were administered in Spanish at three timepoints (prior to, immediately after, and 3 months after attendance of CCOHEP). Descriptive statistics, Fisher's Exact Test, McNemar's test, sign test, and Pearson's chi square-test were conducted in Stata 13.0 to assess the three study objectives.

RESULTS: The SCT constructs of outcome expectations (feeling nervous to brush child's teeth), situation (finding time to brush child's teeth), and behavioral capability (able to brush

child's teeth for two minutes) were found to be significantly associated with a caregiver brushing their child's teeth twice a day at baseline, while self-efficacy to brush when children didn't want to and environment (children owning a toothbrush) were not. Self-efficacy to brush child's teeth with fluoridated toothpaste, outcome expectation (believing that fluoridated toothpaste helps prevent cavities), and environment (children owning fluoridated toothpaste) were all significantly associated with caregivers brushing child's teeth with fluoridated toothpaste at baseline. Eight of the 10 measured SCT constructs improved after attendance at CCOHEP, and were maintained or further improved 3 months after. Improved outcome expectations (feeling nervous to brush child's teeth) and situation (finding time to brush child's teeth), were associated with improved frequency of caregiver brushing their child's teeth at least twice a day. And improvement in self-efficacy to brush child's teeth with fluoridated toothpaste, outcome expectation (believing that fluoridated toothpaste helps prevent cavities), and environment (children owning fluoridated toothpaste) were all significantly associated with improvement in caregivers brushing child's teeth with fluoridated toothpaste

CONCLUSION: SCT constructs including outcome expectations, situation, self-efficacy and environment may be important components in predicting and changing low-income Latino parents' oral hygiene behavior for their children. Further research is warranted.

INTRODUCTION

Early childhood caries (ECC) is tooth decay of the primary dentition in children under age 6^[60]. It affects 23% of the U.S. population and is a health problem that can be a substantial burden on children's quality of life. Pain, malocclusions, speech difficulties and long-term psycho-social consequences can result from untreated ECC^[19, 78]. Pediatric dental care causes 52 million missed school hours, and costs \$35 billion annually^[77, 97, 98]. Mexican American children in the United States (US) experience higher prevalence, severity, and untreated decay compared to their non-Hispanic white and black counterparts^[8, 77, 85].

ECC is a multifactorial and chronic infectious disease that is influenced by factors spanning from the individual to community level^[4]. ECC is predominantly caused by colonization by bacteria that grow and become established with prolonged exposure to fermentable carbohydrates, absence of adequate oral hygiene and poor exposure to fluoride^[6]. Thus, ECC is largely preventable with a regular oral hygiene regimen (an adult brushing a child's teeth twice a day with fluoride toothpaste) and regular visits to a dental professional for cleanings and fluoride varnish^[60, 99]. However, only half of Latino two-year olds are meeting these American Academy of Pediatric Dentists (AAPD) oral hygiene recommendation^[31, 32, 60]. The reasons for not meeting this guideline has not been extensively studied, though there is some evidence that lack of knowledge around when to initiate toothbrushing with a toothbrush and toothpaste and barriers from uncooperative children are contributing factors^[33]. For this young age group, one of the strongest influences on children's oral health comes from parents and caregivers (hereafter referred to generally as parents), gatekeepers to oral hygiene and nutrition practices. Parental

behavior is a complex practice that needs to be better understood in order to know how to help parents improve their habits for their children.

Behavioral theory can be a helpful tool in understanding behaviors and in planning interventions^[39, 40, 100]. Theory-based interventions are more effective than atheoretical interventions, including for matters of oral health^[39, 101]. One such behavioral theory is Bandura's Social Cognitive Theory (SCT), which consists of 11 constructs that relate to behaviors, and has been applied to a wide variety of health behaviors and interventions^[87]. Explicit and consistent use of social or behavioral theoretical constructs in the development of oral health interventions, however, remains sparsely represented in the literature. Some adult oral health behaviors have been investigated in regards to SCT and found to explain flossing behaviors in college students^[46]. However, dyad behavior, such as that of a parent performing a protective behavior for their children might manifest differently than an individual behavior. Examining parents of African American children, a single construct of SCT, maternal self-efficacy, was found to be related to maternal toothbrushing behavior^[43]. An oral health educational intervention based on the Theory of Planned Behavior, a theory similar to SCT, was found to moderately improve oral health related knowledge and behavior in Iran^[102]. However, use of theory for developing educational interventions around ECC in Spanish-speaking populations has yet to be explored.

Contra Caries Oral Health Education Program (CCOHEP) was specifically developed to address this gap. CCOHEP is an oral health education intervention designed for low-income Spanish speaking parents of children up through 5 years of age to improve knowledge, skills and behaviors relating to their children's oral health^[2]. It incorporated constructs from SCT along with results from formative qualitative research with low-income (mainly immigrant) Mexican

American mothers, and additional input from similar low-income Spanish-speaking caregivers^[2, 22, 33, 55, 56, 58, 87].

Based on previous qualitative work with Spanish speaking populations, SCT matched well with previously identified influences on parental toothbrushing behavior for their children^[33]. CCOHEP was designed around the constructs in Bandura's SCT which address personal, social and environmental dimensions of behavior such as self-efficacy which has been shown to be related to maternal tooth brushing behavior for their children^[43, 87]. For example, the second CCOHEP session that focused on oral hygiene topics shows how SCT constructs were incorporated. This session consisted of several items, described here along with a parenthetical note of how they fit with the theoretical model. These items are:

- explanation of how toothbrushing with fluoride toothpaste prevents cavities using both a biomedical explanation and the analogy of protecting your house from ants (outcome expectations);
- participants brushing their own teeth then using disclosing tablets to reveal plaque (observational learning);
- demonstration of proper brushing and flossing technique and materials for adults and children using models (observational learning, situation);
- demonstration and practice of positions to brush a child's teeth including giving feedback to a partner (observational learning and behavioral capability);
- practicing flossing on a model (behavioral capability);
- "lift the lip" exam (behavioral capability);
- discussing behavior management and motivational techniques for brushing children's teeth including group sharing and trouble-shooting to help parents be able to brush

children's teeth under challenging circumstances (emotional coping response, self-efficacy);

- setting toothbrushing goals to revisit at the next class (self-control);
- providing participants with toothbrushes and fluoridated toothpaste for all family members (environment).

CCOHEP consists of a set of four 2-hour interactive sessions led by lay people trained as *promotoras* or community health outreach workers. CCOHEP has been demonstrated to be acceptable and effective at improving oral health related knowledge and self-reported behaviors for this population^[2]. It especially improved parental knowledge around complex oral health concepts such as dental caries being caused by bacteria, the age at which children can brush independently effectively, and the importance of baby teeth. Self-reported oral hygiene behaviors were also affected by CCOHEP, such as improved frequency of parents brushing their children's teeth at night, children avoiding eating and drinking after brushing teeth and before going to bed, and parents visually checking their children's teeth monthly for signs of decay^[1]. These changes were sustained 3 months after the end of the intervention. CCOHEP was less successful at changing dietary behaviors such as nighttime bottle use and frequency of eating sugary foods^[1].

The objective of this paper is to determine if constructs from the SCT as employed in CCOHEP (*i.e.*, behavioral capability, outcome expectations, outcome expectancy, situation, self-efficacy, and environment) are positively associated with regular and optimal parental toothbrushing of children's teeth, if constructs improved after attendance at CCOHEP, and if they are associated with positive behavior change occurring after participation in CCOHEP.

METHODS

Study Design:

In brief, CCOHEP was a single group cohort study, with questionnaires administered prior to, immediately after, and 3 months after participants attended CCOHEP (Pretest, Posttest1 and Posttest2). The methods and primary analyses have been reported elsewhere in detail^[1, 2]. All study procedures were in full accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) and were reviewed and approved beforehand by the Institutional Review Board at the University of California, San Francisco (Approval number 11-05603). The study was undertaken with the understanding and written informed consent of each caregiver.

Setting & Participants:

Low-income Spanish-speaking parents/caregivers of a child aged 0-5 years were recruited in an agricultural city in Northern California through community services such as the health and nutrition program for women, infants and children (WIC), migrant farmworker daycare, and low-income housing. The city does not have optimally fluoridated tap water. The median income was \$49,264, with 21% of the city population below the federal poverty line^[88].

Inclusion criteria included: adult, aged 18+ years; self-identification as Mexican-origin or Latino; Spanish-speaking; self-report of low-income ($\leq 200\%$ federal poverty level); plan to live in the focal city for next 6 months; and be a parent or caregiver for a child aged 0 to 5 years. Recruitment lasted from August through December of 2011. Individuals were enrolled in a rolling fashion into intervention class groups with a goal of having 10 to 14 parents in each class, and at least 8 classes in total. Each class received the same four-session curriculum. Each of the four *promotoras* was scheduled to lead at least two classes. Posttest2 surveys were administered

through March 2012. Questionnaires were verbally administered in-person, in Spanish, by research staff separate than the *promotoras*. Participants received gift cards to a local grocery store (\$20 each for pretest and posttest, and \$30 for the 3 month follow up).

Intervention

Four women with parenting or childcare experience were hired as *promotoras*, and were trained primarily using CCOHEP itself, but including more in-depth oral health detail so that they could field likely questions, as well as be proficient at group facilitation, study-specific procedures and research ethics. The target population and *promotoras* participated in curriculum development and provided feedback to refine content and activities^[2]. The curriculum aimed at increasing parents' knowledge and skills using various didactic approaches as well as skill-building through diverse activities. *Contra Caries* consisted of four sessions: 1- caries etiology and reduction of germ sharing, 2- parent-assisted toothbrushing with fluoride toothpaste, flossing, and child behavior management during toothbrushing, 3- reduction of sugar intake, snacking, diet, and bottle use, and 4- the tooth decay process, fluoride, and how to initiate and what to expect during dental visits. Classes were designed to (a) provide an understandable rationale for parents about why toothbrushing and other protective behaviors matter for young children are important and (b) to collectively lead to improved quality and quantity of oral hygiene.

Variables

Questions included demographic characteristics for the caregiver and their child. If there was more than one child under age 5 years in their family, we asked the participant to respond about the child closest to age 3 years. Questionnaire items from the Oral Health Basic Research Factors Questionnaire (BRFQ) measured parental tooth brushing behavior for their children.

These five questions included 1) frequency of toothbrushing, 2) if toothbrushing occurs right before bed, 3) if anything other than water is consumed by the child after toothbrushing and before going to bed, 4) if fluoridated toothpaste is used, and 5) if an adult assisted the child with toothbrushing. Answers to these questions were dichotomized into either complying with the recommendations of the American Academy of Pediatric Dentistry,^[60] or not. A toothbrushing quality summary variable was also created combining the above questions, with a possible score ranging from 0-5.

Positive behavior change variables were binary variables created as within-person change scores for each item, with a 1 assigned for any improvement between baseline and the first or second posttest.

Author-written questions about SCT constructs, informed by qualitative data and literature about the SCT were used to measure SCT constructs (Table 8). Answers for these questions were binary for knowledge/behavioral capability questions and 5-level Likert scale for the other constructs. Binary difference variables were computed for positive change in SCT constructs, as any positive change versus no change or negative change. If participants answered “don’t know” or “prefer not to answer” they were excluded from analysis for that question. While all eleven constructs were used to develop CCOHEP (Tables 8 and 9), only 6 constructs were measured in the questionnaire as outlined in Table 8.

Table 8: Operationalization and Measurement of Social Cognitive Theory constructs relating to toothbrushing

SCT CONSTRUCT	OPERATIONALIZED FOR PARENT BRUSHING CHILD'S TEETH	HOW MEASURED AND NUMBER OF ITEMS
Environment	• Access to tooth brush and toothpaste • Time and space to brush teeth	1. Access to tooth brush 2. Access to fluoridated toothpaste
Situation	• Perceived access to brush, toothpaste, time and space for brushing	1. Perceived time for brushing
Behavioral capability	• Knowledge of brushing technique • Ability to brush child's teeth properly • Ability to manage child's behavior while brushing • Knowing and being able to brush for proper time	1. Know to brush with fluoride toothpaste 2. Know child should avoid drinking/ eating after brushing before bed 3. Know adult assistance needed until child reaches age 6 4. Know to brush at least twice a day
Outcome Expectations	• Child's behavior problems • Cleaner teeth, better breathe odor • Toothbrushing with fluoride toothpaste prevents cavities	1. Expect toothbrushing to prevent caries
Outcome Expectancy	• How parent feels when brushing child's teeth	1. Get nervous to brush child's teeth
Self-Efficacy	• Self-confidence to perform correct toothbrushing under a variety of conditions	1. How sure parents are that they can brush child's teeth even when child doesn't want to 2. Don't brush child's teeth if they don't cooperate 3. How sure they can brush with fluoride toothpaste 4. Doesn't let child fall asleep before brushing 5. How sure they can prevent child from getting cavities

Table 9: Operationalization of Social Cognitive Theory constructs relating to toothbrushing that were not measured with the questionnaire

Self-control	At the end of each session everyone set their own goal, and then it was revisited at the start of the next session. <i>Promotora</i> and classmates provided problem solving and social support
Observational learning	Every skill was demonstrated and explained in detail by the <i>promotora</i> as well as other classmates
Reinforcements	Parents received positive reinforcement from the <i>promotoras</i> and classmates at each class. Lessons discussed parents giving positive reinforcement to their children for cooperating with behaviors, such as letting their parents brush their teeth.
Emotional Coping Response	Social support and strategies were provided by <i>promotoras</i> and classmates around child behavior management and motivation
Reciprocal Determinism	This was an underlying framework for CCOHEP, which simultaneously targeted the environment, behavior and personal characteristics.

Study Size

The study aimed to enroll 100 eligible participants at baseline, which was determined based on budgetary and timeline limitations; there was no a priori sample size calculation.

Statistical methods

All statistical analyses were performed using Stata Software 13^[89]. Descriptive statistics were used to summarize demographic characteristics. Logistic and ordinal regression was used to determine the relation between demographic factors, self-reported oral hygiene behaviors and SCT constructs. Fisher's Exact test was used to compare SCT constructs with baseline oral hygiene behaviors and behavior change variables between each timepoint. Analyses of within-person changes in SCT constructs between pre- and posttest1 (initial change), as well as between posttest1 and posttest 2 (delayed change or maintenance) were based on McNemar's test for

binary variables (knowledge/behavioral capability) and sign test for ordinal categorical variables (all other SCT constructs). Analyses of the relationship between positive changes in SCT construct values and positive changes in behaviors were assessed with Pearson chi-square test. Sensitivity analyses were performed to assess the influence of participant attrition, setting posttest1 and posttest2 values to baseline values for participants lost to follow up.

RESULTS

CCOHEP enrolled 105 caregivers who took the initial survey and attended at least one class ($n= 105$ baseline, 95 at first follow up, 79 at second follow up). The sample was primarily Mexican-born mothers about half of whom had not completed high school, who were parents of an average of two U.S.-born children and had lived in the U.S. for an average of 12 years (Table 10).

Table 10: Self-Reported Demographic Characteristics of Low-Income Spanish-Speaking Parent or Caregiver and their Child Closest to 3 Years of Age (N=105)

Caregiver Characteristic	Count (%) or Mean $\pm$ SD; median; range
Mothers	81 (77%)
Age (years)	33.7 $\pm$ 8; median=33; range=18-57
Caregiver birth country	
U.S.	11 (10%)
Mexico	91 (87%)
Other	3 (3%)
Years living in the U.S. if foreign born (n=94)	12.3 $\pm$ 6.6; median=11; range=3-31
Years completed in School	
6 years or less	35 (33%)
7-11 years	18 (17%)
High School diploma	33 (31%)
More than High School	19 (18%)
Self-rated oral health	
Excellent	3 (3%)
Very Good	3 (3%)
Good	19 (18%)
Average (translated as “regular”) [§]	53 (50%)
Bad	27 (25%)
Number of children in household	2.4 $\pm$ 1.1; median=2; range=0-5*
Child Characteristic	
Age (years)	3.0 $\pm$ 1.3; median=3; range=0-5
Female	47 (45%)
U.S. Born	102 (98%)
First born child	38 (36%)
Never had dental visit	14 (13%)
Received fluoride varnish in past year	50 (48%)
Currently take fluoride supplement	12 (18%) [†]
Child stopped using a baby bottle before age 2 years [‡]	29 (31%) [‡]
Caregiver-rated child oral health	
Excellent	14 (13%)
Very Good	10 (10%)
Good	44 (42%)
Average (translated as “regular”) [§]	35 (33%)
Bad	2 (2%)

This table taken from Table 3 in Hoeft et al BMC Oral Health^[2]

* Caregivers with zero children were grandparents or childcare providers who did not have children under 5 of their own, but cared for such children regularly

[†] n=65 for the question about fluoride supplements, due to poorly followed skip pattern in the survey

[§] “regular” in Spanish could have a different implication than “average” in English^[103]

[‡] n=94; (9 children under age 2 still using the bottle excluded from this question)

As reported by Hoeft and colleagues^[1], at baseline, 13% of participants self-reported performing all 5 toothbrushing behaviors correctly; the average number of correct behaviors was 2.6 ± 1.6 . The most commonly reported behaviors were brushing child's teeth twice a day (82%) and using fluoridated toothpaste (86% of those who brushed). The least reported behavior was brushing the child's teeth before bedtime every day in the last week (52%). At baseline, there were no significant differences in parent age, parent education level, child gender or child birth order between those participants who reported all 5 toothbrushing behaviors, and those who didn't ($p > 0.1$). For parent's toothbrushing frequency of their children's teeth at baseline, however, child age mattered: parents whose children were one year old or younger were less likely to report brushing their child's teeth twice daily than were parents of older children ($p = 0.018$).

Results from Posttest1 (immediately after completion of CCOHEP, 1 month after baseline) showed 44% ($p < 0.001$) of participants reporting performing all 5 toothbrushing behaviors correctly (up from 13%), and the average number of correct behaviors was 4.2 ± 0.9 (up from 2.6) ($p < 0.001$)^[1]. Of participants with less than perfect scores at baseline, 79% improved at least one behavior between baseline and Posttest1. McNemar's test for pairwise comparison examined within-person change between Pretest and Post1, assessed initial changes from the intervention, and found 4 of the 5 reported toothbrushing behaviors showing statistically significant improvement between Pretest and Posttest 1 and either maintained or continued to improve between Posttest1 and Posttest 2 (Figure 4). Only adult assistance with brushing child's teeth every night did not statistically improve between the first two timepoints ($p = .257$), though it improved between Posttest 1 and Posttest 2. ($p = 0.0001$).

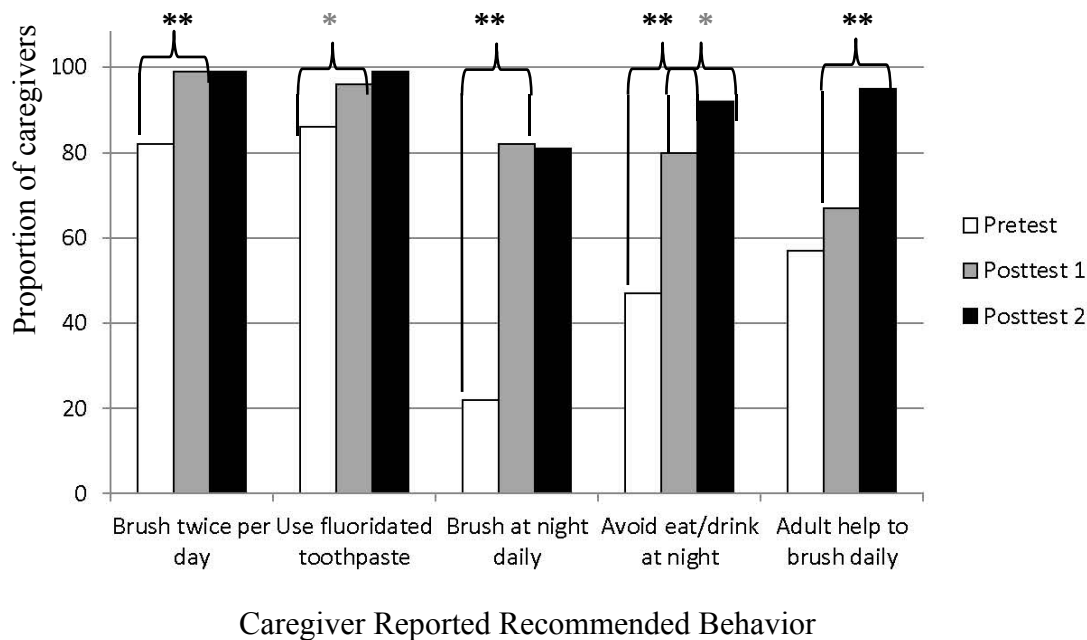


Figure 4: Comparison of Proportion (%) of Parents Reporting Performing AAPD Recommended Oral Hygiene Practices for Their Young Child between Pretest, Posttest1, Posttest2

adapted from Figure 2 in Hoeft et al^[1]

* Indicates statistically significant improvement with $p < 0.05$

** Indicates statistically significant improvement with $p < 0.0001$

SCT construct scores

The distribution of SCT constructs is reported in Table 11, along with the relation between each SCT construct to the toothbrushing behavior it was hypothesized to predict and the p-value from the Fisher's Exact Test. Caregiver-reported brushing of child's teeth twice or more per day was related to:

- feeling nervous to brush child's teeth (outcome expectations),
- difficulty to find time to brush child's teeth (situation), and
- parent's ability to brush their child's teeth for 2 minutes (behavioral capability).

That same behavior, of caregiver-reported brushing of child's teeth twice or more per day, was not related to:

- feeling sure they could brush child's teeth if child didn't want to (self-efficacy),
- child having his own toothbrush (environment), and
- not brushing a child's teeth if they don't cooperate (self-efficacy).

The self-reported behavior of brushing child's teeth with fluoride toothpaste was related to feeling sure they could brush child's teeth with fluoride toothpaste (self-efficacy), how sure parents felt that fluoride toothpaste prevents cavities (outcome expectations), and child having fluoride toothpaste (environment). The caregiver-reported behavior of brushing their child's teeth before bed was related to not brushing child's teeth if the child falls asleep before brushing (self-efficacy). The behavior of child eating or drinking after brushing but before going to sleep was not related to parental knowledge that brushing teeth before bed was good for teeth. The behavior of parents regularly brushing their children's teeth was not related to knowing the correct age that children can brush independently.

Table 11: Behaviors and SCT constructs at baseline

Behavior	n	SCT Construct	Response option					Mean SCT construct score (SD) for those doing correct behavior those not doing correct behavior	Statistic ¹ (p-value)
			1*	2	3	4	5		
Brush child's teeth twice a day or more 84 (82%) n=102	n=78	Self-Efficacy: How sure parents are that they can brush child's teeth even if child doesn't want to	0/5	3/ 13	12/24	5/12	13/24	3.85 (1.06)	0.112
								3.20 (1.34)	
	n=105	Environment: Child has own toothbrush	0/3	0/0	0/0	0/1	50/101	5.0 (0.00)	0.245
								4.76 (0.92)	
	n=105	Outcome Expectations: Feel nervous to brush child's teeth	1/7	0/1	0/8	0/2	49/87	4.92 (0.57)	0.000
								4.18 (1.37)	
	n=105	Situation: Difficult to find time to brush child's teeth	3/6	1/2	1/15	1/4	44/78	4.64 (1.06)	0.001
								4.16 (1.12)	
	n=104	Behavioral Capability: Can brush child's teeth for 2 minutes	3/14	3/4	9/19	0/7	34/60	4.20 (1.29)	0.005
								3.65 (1.57)	
	n=105	Self-efficacy: Parents don't brush child's teeth if the child doesn't cooperate (reverse coded)	0/1	1/5	19/45	7/15	23/39	4.04 (0.97)	0.265
								3.61 (1.05)	

Table 11 Continued:

Behavior	n	SCT Construct	Response option					Mean SCT construct score (SD) for those doing correct behavior those not doing correct behavior	Statistic (p-value)
			1*	2	3	4	5		
Brush with fluoride toothpaste 69 (86%) n=80**	n=101	Self-efficacy: How sure parents are that they can brush their child’s teeth with fluoride toothpaste	0/6	2/7	11/23	3/6	51/59	4.54 (0.88)	0.000
								3.05 (1.39)	
	n=79	Outcome Expectations: How sure parents feel that fluoridated toothpaste can help prevent cavities	1/3	3/6	12/29	8/12	25/29	4.02 (1.17)	0.005
								3.24 (0.95)	
	n=102	Environment: Child has fluoridated toothpaste	1/19	0/0	1/4	0/0	67/79	4.91 (0.54)	0.000
								2.64 (1.90)	
Brushed child’s teeth before bed every day last week 58 (55%) n=105	n=80	Self-efficacy: Parent doesn’t brush child’s teeth if the child falls asleep before brushing (reverse coded)	0/5	0/2	18/38	6/9	19/26	4.02 (0.94)	0.006
								3.14 (1.21)	
Child didn’t eat or drink after brushing in last week 47 (45%) n=105	n=105	Behavioral capability: Parent knows that eating after brushing teeth just before going to bed at night is bad for child’s teeth	3/8		44/97			0.94 (0.25)	0.729
								0.91 (0.28)	
Adult assistance with brushing child’s teeth every night 55 (52%) n=105	55 (57%) n=96	Behavioral Capability: Parent knows the correct age children can brush independently	38/74		17/31			0.31 (0.47)	0.832
								0.28 (0.45)	

[†] Fisher's Exact Test

* 1= no, never, or not at all sure; 5=yes, always, or extremely sure/positive; items marked (reverse coded) have had their answers recoded so that 5 corresponds to the positive belief/behavior

** additional 21 (20%) answered "don't know", coded as not performing the behavior

Within-person changes in SCT construct scores

Analyses of within-person changes in SCT construct scores between pre- and posttest1 (initial change), as well as between posttest1 and posttest 2 (delayed change or maintenance) were based on McNemar's test for binary variables (knowledge/behavioral capability) and sign test for ordinal categorical variables (all other SCT constructs) (see Table 12). There was positive change between baseline and Posttest1 for eight of the ten measured constructs:

- parents feeling sure they could brush child's teeth even if child didn't want to (self-efficacy),
- parents feeling nervous to brush child's teeth (outcome expectations),
- parents having difficulty to find time to brush child's teeth (situation),
- parent's feel able to brush their child's teeth for 2 minutes (behavioral capability),
- parent not brushing a child's teeth if the child doesn't cooperate (self-efficacy),
- parents feeling sure that they can brush child's teeth with fluoride toothpaste (self-efficacy),
- parents feeling sure that fluoride toothpaste prevents cavities (outcome expectations), and
- child having fluoride toothpaste (environment).

These changes were all maintained between posttest1 and posttest2. Not brushing a child's teeth if they don't cooperate improved further between posttest 1 and posttest 2.

Two SCT construct scores did not improve to statistical significance: 1) Child having their own toothbrush (environment) was very high at baseline (96%) and improved to 100% at posttest1 but there was no room for statistical significance in that change, and 2) parent doesn't

brush child's teeth if the child falls asleep (reverse coded) before brushing (self-efficacy) improved from an average of 3.61 to 4 between pretest and posttest1, but this was not a statistically significant change ($p=0.0522$). For this self-efficacy question about brushing a child's teeth if the child falls asleep before brushing, 27% of caregivers reporting a higher confidence at posttest1 than they did at pretest, most (61% of caregivers) responded the same at both timepoints, and 11% answered with lower confidence at posttest 1 than they did at pretest (baseline).

Sensitivity analyses found no statistically significant change in results for differences between baseline and Posttest 1 and all but two variables between Posttest1 and Posttest 2. The construct of parents brushing their child's teeth for two minutes would have decreased its score rather than maintained the full improvement if all of the missing values at Posttest2 had been reported as baseline values ($p=0.0043$ instead of $p=0.099$). And the construct of not brushing a child's teeth if they don't cooperate would have maintained rather than further improved between Posttest1 and Posttest 2 ($p=0.0652$ instead of $p=0.011$).

Table 12: SCT constructs at Pretest, Posttest1 and Posttest 2

	Pretest (Baseline) (N=105) mean(SD)	Posttest1 (1 month) (n=95) mean(SD)	Posttest2 (4 months) (n=79) mean(SD)	Within- person change between Pretest and Posttest1	Within- person change between Posttest1 and Posttest2
Self-Efficacy: How sure parents are that they can brush child's teeth even if child doesn't want to	3.47 (1.27)	4.49 (.78)	4.58 (0.61)	$\uparrow^*$ $p<0.0001$	$\rightarrow^{**}$ $p=0.42$
Environment: Child has own toothbrush	4.88 (0.68)	5.0 (0)	5.0 (0)	$\rightarrow$ $p=0.50$	$\rightarrow$ $p=1$
Outcome Expectations: Feel nervous to brush child's teeth	4.53 (1.13)	4.83 (0.65)	4.92 (0.50)	$\uparrow$ $p=0.0075$	$\rightarrow$ $p=1$
Situation: Difficult to find time to brush child's teeth	4.39 (1.16)	4.81 (0.63)	4.88 (0.56)	$\uparrow$ $p=0.0052$	$\rightarrow$ $p=1$
Behavioral Capability: Parent can brush child's teeth for 2 minutes	3.91 (1.46)	4.49 (1.1)	4.41 (0.89)	$\uparrow$ $p=0.0007$	$\rightarrow$ $p=0.099$
Self-efficacy: Don't brush child's teeth if the child doesn't cooperate	3.82 (1.02)	4.45 (0.82)	4.78 (0.58)	$\uparrow$ $p<0.0001$	$\uparrow$ $p=0.011$
Self-efficacy: How sure parents are that they can brush their child's teeth with fluoride toothpaste	4.04 (1.28)	4.94 (0.32)	4.96 (0.19)	$\uparrow$ $p<0.0001$	$\rightarrow$ $p=0.688$
Outcome Expectations: How sure parents feel that fluoridated toothpaste can help prevent cavities	3.73 (1.15)	4.93 (0.31)	4.94 (0.30)	$\uparrow$ $p<0.0001$	$\rightarrow$ $p=1$
Environment: Child has fluoridated toothpaste	4.18 (1.58)	4.98(0.21)	5.0 (0)	$\uparrow$ $p<0.0001$	$\rightarrow$ $p=1$
Self-efficacy: Doesn't brush child's teeth if the child falls asleep before brushing (reverse coded)	3.61 (1.15)	4.0 (0.87)	4.05 (0.92)	$\rightarrow$ $p=0.0522$	$\rightarrow$ $p=.2810$

* $\uparrow$ indicates statistically significant improvement between timepoints

** $\rightarrow$ indicates no statistically significant change between timepoints

In order to more closely examine the subset of participants who improved their behaviors and SCT construct scores between baseline and Posttest1, rather than maintaining or changing in the negative direction, a new binary variable for improvement of each behavior and SCT construct score was created. Comparison of behavior improvement and its relation with SCT construct score improvement, tested by Pearson Chi-square, is reported in Table 13. Of the 44% of participants who improved their behavior of brushing child's teeth at least twice a day, 29% reported feeling less nervous to brush their child's teeth (outcome expectations) and 36% reported decreased difficulty in finding time to brush child's teeth (situation) at posttest 1, both of which were statistically related to the behavior change ($p=0.003$ and 0.026). While the other SCT construct scores also improved between baseline and posttest1, those scores did not occur significantly more in the people who improved their behavior compared to those who did not improve. Overall, 29% of the caregivers improved brushing their child's teeth with fluoride toothpaste, and all three SCT constructs measuring that [feeling sure they could brush child's teeth with fluoride toothpaste (self-efficacy), how sure parents felt that fluoride toothpaste prevents cavities (outcome expectations), and child having fluoride toothpaste (environment)] were related to the behavior change ($p<0.0001$). Improvement in the other three behaviors (brushing at night, not eating or drinking after brushing and before bed, parent daily assistance with brushing) was not related to improvements in their related SCT construct scores.

Table 13: SCT Construct score change related to behavior change from baseline to Posttest1

% with improved behavior <i>n</i>	SCT Construct	% with improved SCT construct score	% of those with positively improved behavior who positively improved SCT score	Pearson Chi-square <i>p</i> -value
Brush child's teeth twice a day or more 42 (44%) <i>n</i> =95	Self-Efficacy: How sure parent is that they can brush child's teeth even if child doesn't want to	37/67 55%	17/34* 50%	<i>p</i> =.383
	Environment: Child has own toothbrush	2/93 2%	1/42 2%	<i>p</i> =0.500
	Outcome Expectations: Feel nervous to brush child's teeth	15/93 15%	12/42 29%	<i>p</i> =0.003
	Situation: Difficult to find time to brush child's teeth	23/93 25%	15/42 36%	<i>p</i> =0.026
	Behavioral Capability: Can brush child's teeth for 2 minutes	31/92 34%	18/42 43%	<i>p</i> =0.088
	Self-efficacy: Parent doesn't brush child's teeth if child doesn't cooperate (reverse coded)	44/94 47%	17/42 41%	<i>p</i> =0.269
Brush with fluoride toothpaste 28 (29%) <i>n</i> =95	Self-efficacy: How sure they can brush their child's teeth with fluoride toothpaste	37/90 41%	21/27 78%	<i>p</i> <0.0001
	Outcome Expectations: How sure they feel that fluoridated toothpaste can help prevent cavities	40/66 61%	19/20 95%	<i>p</i> <0.0001
	Environment: Child has fluoridated toothpaste	20/92 22%	16/26 62%	<i>p</i> <0.0001
Brushed child's teeth before bed every day last week 28 (29%) <i>n</i> =95	Self-efficacy: Parent doesn't brush child's teeth if child falls asleep before brushing (reverse coded)	19/70 27%	7/22 32%	<i>p</i> =0.552
Child didn't eat or drink after brushing but before bed in last week 34 (36%) <i>n</i> =95	Behavioral capability: know that eating after brushing teeth at night is bad for teeth	6/89 7%	2/33 6%	<i>p</i> =0.387

Table 13 continued:				
% with improved behavior <i>n</i>	SCT Construct	% with improved SCT construct score	% of those with positively improved behavior who positively improved SCT score	Pearson Chi-square <i>p</i>-value
Adult assistance with brushing child's teeth every night 22 (23%) <i>n</i> =95	Behavioral Capability: know the correct age children can brush independently	62/95 65%	16/22 73%	<i>p</i> =0.101

* Number is less than the total due to questions being added to the survey after the first few waves of classes

DISCUSSION

This is the only study of which we are aware that examines improvements of low-income Spanish-speaking parents' oral hygiene behaviors for their children through theory-based education. The study provides initial theory-based evidence of positive effects of the CCOHEP on oral hygiene behavior and behavior change. Proper oral hygiene behaviors, including parent-assisted twice-daily brushing of their children's teeth with fluoridated toothpaste is an essential component to ECC prevention, however parents do not always feel comfortable performing these behaviors on their young (not always cooperative) children, nor do they perform it following national guidelines^[31-33, 60, 99]. CCOHEP was based on Bandura's SCT, and designed specifically for this population, whose children are at particularly high risk for ECC, with a focus on improving parental oral hygiene behaviors for their children. Through this study, the theory-based education utilized in CCOHEP has been shown to lead to improved outcomes in parental knowledge, willingness, and ability to perform basic oral hygiene routines for their young children.

Our study showed that 7 of the 12 measured SCT constructs on which CCOHEP was based, were associated with positive toothbrushing behaviors at baseline. Caregiver-reported brushing of their child's teeth twice or more per day was related to outcome expectations, situation, and behavioral capability. The self-reported behavior of brushing child's teeth with fluoride toothpaste was related to self-efficacy, outcome expectations and environment. The caregiver-reported behavior of brushing their child's teeth before bed was related self-efficacy. Eight of the 12 measured SCT construct scores improved after attendance at CCOHEP, and these improvements were maintained or further enhanced 3 months later. Improvement in toothbrushing behavior was associated with 5 of the 11 SCT constructs used in this study.

The SCT constructs shown to be related to oral hygiene behaviors are consistent with previously identified influences on toothbrushing behavior.^[33] For example, feeling nervous to brush children's teeth (outcome expectations) whether due to a child's age or size, sensitivity to toothbrushing, or a child's negative reaction to having his teeth brushed, was discussed by many parents as a barrier to regular toothbrushing.

In our study, nearly all children owned toothbrushes at baseline, so there was no room for improvement in that construct. Two self-efficacy questions related to a parent brushing a child's teeth when the child doesn't want to or doesn't cooperate. This construct was not related to toothbrushing frequency or behavior change, however, even though child resistance was an issue that caregivers have discussed as being a barrier to brushing children's teeth, a barrier they struggled to overcome. The other two SCT constructs that were not related to behaviors were behavioral capability constructs measured as knowledge items. In this study knowledge was quite high at baseline, but it has been shown repeatedly that knowledge is insufficient to predict behavior.

Two of the three self-efficacy items measured in this study were not related to the basic oral hygiene behaviors of toothbrushing, a finding which is different than those reported in previous studies.^[43] Finlayson and colleagues found maternal self-efficacy, measured with factors including nighttime brushing when the mother felt under stress, depressed, anxious, too busy, tired, worried about other things in their life, bothered by crying child, bothered by child not staying still, and told by child that they don't feel like brushing, to be related to toothbrushing frequency.^[104] Finlayson and colleagues found generally high self-efficacy scores, with the most "not confident" scores (still less than 12% of total participants) occurring for being tired, too busy, or depressed. Thus the questions about child cooperation were not influencing factors in the variability in the self-efficacy score, and the difference in findings between this study and Finlayson's previous work could be attributed to differences in measurement. Also, that previous study was with African-American mothers, and there could be different influences in behaviors in that different population. This difference in findings from previous work highlights the importance of having very specific self-efficacy measures and carefully specifying self-efficacy for *what* when discussing this concept. The generic term "self-efficacy" is too broad to be sufficiently informative just on its own.

The eight SCT constructs that improved in score between baseline and posttest 1 suggest that attendance at CCOHEP influenced these changes. Five out of the seven SCT constructs that were associated with behavior performance at baseline were associated with improvement in SCT construct scores and behavior. These five SCT constructs are: feeling nervous to brush child's teeth (outcome expectations), feeling that it is difficult to find time to brush child's teeth (situation), feeling sure they could brush child's teeth with fluoride toothpaste (self-efficacy), how sure parents felt that fluoride toothpaste prevents cavities (outcome expectations), child

having fluoride toothpaste (environment). This study was not designed to test causality of this association, but it provides clear hints that these could be constructs associated with toothbrushing frequency and brushing with fluoride toothpaste, and potentially are operating as mechanisms of action facilitating improvements in those behaviors.

This study is limited by its small sample size and a lack of comparison group, so threats to validity cannot be ruled out. We attempted to minimize threats to validity by calculating within-person change scores, and by having the two measurement timepoints close together to minimize influences from natural childhood development. Other limitations include restricted number of items measured (not all SCT constructs). However, this study has a broader representation of SCT constructs than previous studies examining self-efficacy alone. The SCT questionnaire items were written by the first and senior study authors, and while informed by qualitative research, they have not been tested elsewhere or evaluated for reliability and validity. In addition, there is some missing data due to changes in the survey and participant attrition. Sensitivity analyses suggest that findings are not influenced by participant attrition, with the exception of maintenance of parents reported ability to brush for two minutes. Some of the analyses comparing change in behavior with change in SCT construct scores (Table 6) were being performed in small pools of people. The impact on results of engaging in a similar study with a different Spanish-speaking population, such as in a different geographic area of the US, from a different socio-economic level or migration history, such as from a different home country, is unknown.

Despite these limitations, this study makes an important contribution to the literature. This is one of the only studies examining behavioral change based on theoretical constructs relating to oral hygiene, and the only one to examine this in relation to a Latino population. It

provides initial data suggesting possible mechanisms of action of behavior change relating to parental toothbrushing behavior. As such it can inform other intervention efforts and help create more efficient and targeted interventions. Further research with an experimental study design and larger sample is warranted.

Acknowledgements:

This research was supported by the National Institute of Dental & Craniofacial Research of the National Institutes of Health under Awards Number R21DE019210 (project development and data collection); F31DE023282 (data entry and analysis, manuscript writing); U54DE019285, U54DE019275, & U54DE019259 (development of survey items) and REAC (Cox fund) Award from the University of California San Francisco (initial qualitative research that informed data collection). The content is solely the responsibility of the authors and does not necessarily represent the official views of the funders.

We thank the study participants for sharing their feedback, Estela Pantoja Guzman for conducting the field research, the four *promotoras* who facilitated the CCOHEP classes, Darby Henry for assistance with data entry, staff from Community Oral Health Services in Monterey County, CA, for their support and sharing their office, and the Center to Address Disparities in Children's Oral Health (CAN DO) at the University of California San Francisco for their feedback and encouragement during the entire study process.

Conclusion

This dissertation has investigated the acceptability, feasibility, effectiveness and mechanisms of action underlying *Contra Caries* Oral Health Education Program (CCOHEP), a theory-based, *promotora*-led program that was designed for low-income, Spanish speaking parents of young children. Educational messages focused particularly on prevention of early childhood caries (ECC), a common dental disease that disproportionately affects Latino children. With an overarching objective of expanding the science and literature for evidence-based oral health interventions for high risk populations, this project builds a strong foundation from which to understand more about low-income Spanish-speaking parents' knowledge and behaviors around their children's oral health, and evaluates whether and how CCOHEP serves to improve protective oral health behaviors (especially optimal toothbrushing behaviors).

CCOHEP outlined an initial curriculum derived from the extant literature and advice from oral health professionals, especially but not exclusively pediatric and public health dentists. It then solicited community feedback through focus groups to establish the best ways to deliver the educational intervention as well as to refine the CCOHEP curriculum and assess its acceptability. Then it trained *promotoras*, who further refined the curriculum, ensuring its accessibility to a wide audience and sensitivity to the cultural values and background of participants. It implemented the curriculum and assessed outcomes using a longitudinal survey. This study described the development and implementation of an oral health intervention, and then measured its acceptability and effectiveness. It also evaluated the role of the Social Cognitive Theory in oral health-related behavior and behavior change, something lacking in the literature, especially for Spanish-speaking populations, a group with a very high ECC burden. Though small, this rigorously designed and conducted study produced important results.

Chapter 1, *Using community participation to assess acceptability of "Contra Caries", a theory-based, promotora-led oral health education program for rural Latino parents: a mixed methods study*,^[2] assessed the acceptability and feasibility of CCOHEP for low-income, Spanish-speaking parents of children 1-5 years and solicited community feedback to refine the CCOHEP curriculum. Parents felt their children's oral health was important. They were not only interested in, but actually attended classes focused on increasing their knowledge and skills with respect to early childhood oral health. The *Contra Caries* content and format was perceived as acceptable by parents. Strong opinions about curriculum content were expressed for including information on how caries starts and progresses, weaning from the bottle, oral health care for children and adults, motivational strategies for children's tooth brushing, dental visits and cavity restorations. Having had a similar population of parents participate in the focus groups in which curriculum development and revision process occurred, likely played an important role in the high acceptability of the program by the parents who participated in the classes.

Chapter 2, *Effectiveness evaluation of Contra Caries Oral Health Education Program for improving Spanish-speaking parents' preventive oral health knowledge and behaviors for their young children*,^[1] assessed whether there were changes in parental knowledge and self-reported behavior after attending CCOHEP. Results show CCOHEP was effective at improving low-income Spanish-speaking parents' oral hygiene knowledge and behaviors for their children under age 5 years. At baseline, only 13% of parents self-reported providing optimal toothbrushing behaviors for their children, despite scoring high on oral health knowledge measures. Immediately after attending CCOHEP, however, optimal caregiver-reported behavior performance improved to 44%, and 3 months after attendance, rose to 66%. Four of the five

reported toothbrushing behaviors improved between Pretest and Posttest1, especially brushing at night. And all 5 behaviors had improved by the three month follow up survey.

Chapter 3, *Social cognitive theory and Spanish-speaking parents' preventive oral hygiene behaviors for their young children*, examined if SCT constructs (behavioral capability, outcome expectations, self-efficacy, situation, and environment) were positively associated with protective oral health behaviors, whether these constructs changed for individuals after participation in CCOHEP, and if those changes were associated with behavior changes. This chapter reports that 7 of the 12 measured SCT constructs on which CCOHEP was based, were associated with toothbrushing behaviors at baseline. Caregiver-reported brushing of their child's teeth twice or more per day was related to outcome expectations, situation, and behavioral capability. The self-reported behavior of brushing child's teeth with fluoride toothpaste was related to self-efficacy, outcome expectations and environment. The caregiver-reported behavior of brushing their child's teeth before bed was related to self-efficacy. Eight of the 12 measured SCT construct scores improved after attendance at CCOHEP, and these improvements were maintained or further enhanced 3 months later. Improvement in toothbrushing behavior was associated with 5 of the 11 SCT constructs used in this study. This is one of the only studies examining theoretical constructs relating to oral hygiene behaviors and behavior change, and the only one to examine this in relation to a Latino population.

This body of work contributes to the sparse literature evaluating oral health education and behavioral outcomes, especially for low-income Spanish speaking populations. While many oral health educational programs for children exist^[38], most are developed and delivered in English, inaccessible to monolingual migrant and immigrant families whose children are often at particularly high risk for ECC. Very few of these educational programs are evaluated and

published in the scientific literature. Having evidence-based interventions is essential for assuring effective use of resources, developing policy, and ensuring health is actually improved by public health programs. This study is particularly unusual in its inclusion and assessment of the role of Social Cognitive Theory, finding that multiple constructs besides self-efficacy can contribute to behavior and behavior change.

Overall, this research was limited by a small sample size and lack of comparison or control group. Effects of these shortcomings were minimized through within-person analyses, sensitivity analyses, and having a dedicated research staff who were not the *promotoras* administer the survey. However, future research with a larger sample and experimental research design this initial study provides a basis to confirm the results found here.

This study makes an important contribution and moves forward to present literature. It is the first study to evaluate a theory-based oral health intervention for low-income, Spanish speaking parents from so many angles: acceptability, feasibility, effectiveness, and theoretical constructs as mechanisms of action. This body of work provides in-depth pilot data around CCOHEP, suggesting a suitable approach to improving parental behaviors for their children's oral health, as well as some of the theoretical constructs associated with behavior change. It lays the groundwork for future research to further test CCOHEP in a larger, more rigorously designed study so that fully evidence-based oral health education can be available for this vulnerable population, ultimately improving children's oral health.

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